

TECHNICAL FISHERY REPORT 94-10



Alaska Department of Fish and Game
Commercial Fisheries Management
and Development Division
P.O. Box 25526
Juneau, Alaska 99802-5526

June 1994

Origins of Sockeye Salmon in 1992 Eastside Bristol Bay Fisheries Based on Linear Discriminant Function Analysis of Scale Patterns

by

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and

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ACKNOWLEDGMENTS

The entire Eastside Bristol Bay full-time and seasonal staff of the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division assisted in collecting data used to generate the 1992 stock composition estimates.

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ABSTRACT

Stock composition of the 1992 commercial sockeye salmon *Oncorhynchus nerka* harvests in Naknek-Kvichak, Egegik, and Ugashik Districts, Bristol Bay, Alaska, were estimated with scale pattern analyses and age composition. Scale measurements from age-2.2 and -2.3 sockeye salmon escapement samples were used to build discriminant functions which allowed the stock composition of these age groups in the commercial catch to be estimated. Stock origins for other age groups were estimated by combining age-2.2 and -2.3 scale pattern analyses with escapement age compositions. Most sockeye salmon harvested had originated from rivers within the fishing district; however, harvest of outside stocks occurred in every district. Of the estimated 9,329,663 sockeye salmon caught in Naknek-Kvichak District, 41.7% were from Kvichak River, 33.0% from Naknek River, 14.0% from Egegik River, and 11.3% from Ugashik River. The estimated 15,677,236 sockeye salmon caught in Egegik District were composed of the following stocks: 83.5% Egegik, 7.3% Naknek, 6.5% Ugashik, and 2.7% Kvichak Rivers. The estimated Ugashik District harvest of 3,355,095 sockeye salmon was 86.1% Ugashik River, 6.1% Egegik River, 5.2% Naknek River, and 2.6% Kvichak River origin. Estimated exploitation rates were 88.2% for Egegik River, 73.3% for Naknek River, 69.3% for Ugashik River, and 48.3% for Kvichak River stocks.

KEY WORDS: Sockeye salmon *Oncorhynchus nerka*, Bristol Bay, scale pattern analysis, linear discriminant analysis, stock composition, exploitation rate

INTRODUCTION

To facilitate discrete stock management, the Bristol Bay sockeye salmon *Oncorhynchus nerka* fishery is restricted to districts located near the mouths of major spawning streams (Figure 1). However, the close proximity of these spawning streams and annual variation in migratory routes causes stock mixing in the fisheries.

The Bristol Bay Management Area is divided into two general fisheries, the East and West Side. The Eastside fishery is composed of Naknek-Kvichak, Egegik, and Ugashik Districts (Figure 1); the West Side fishery includes Nushagak and Togiak Districts. Naknek-Kvichak District is subdivided into Naknek and Kvichak Sections.

From 1956 to present, stock composition estimates from Naknek-Kvichak District harvests have been based on escapement age composition estimates from Kvichak, Alagnak (Branch), and Naknek Rivers. Total runs of sockeye salmon to Egegik and Ugashik Rivers were estimated by adding the district catch to the district escapement. This standard method assumes (1) that all fish harvested in a district were returning to rivers within that district, and (2) equal exploitation among stocks. Complete results of the standard method have been summarized and published in separate reports (Stratton 1991; Stratton and Crawford 1992). Bernard (1983) evaluated the biases inherent with this procedure.

More recently a second method based on linear discriminant function analysis of scale patterns has been used as well as the standard method. Use of this method began when decreased catches of sockeye salmon in Naknek-Kvichak District in 1985 and 1986 prompted concerns that these fish were being intercepted in Egegik and Ugashik Districts where catches were large (Figure 2). Straty (1975), after conducting a tagging study from 1955 to 1957, concluded that Eastside sockeye salmon stocks mixed in all Eastside districts and that West Side stocks were not present in appreciable numbers in Eastside districts. Examining the 1985 Eastside commercial catches, Fried and Yuen (1985) found that scale pattern analysis could accurately identify major Eastside sockeye salmon stocks. Scale pattern studies were expanded and stock compositions of Eastside district catches were recently estimated by Burns (1991) for the 1983 and 1984 runs; estimates for 1986 to 1991 have also been completed (Bue et al. 1986; Cross and Stratton 1989; Cross and Stratton 1991; Cross et al. 1992; Stratton et al. 1992; Stratton and Miller 1993).

Objectives of this ongoing investigation of Eastside sockeye salmon runs include (1) estimation of stock composition in Eastside commercial sockeye salmon harvests; (2) estimation of total run by river; and (3) comparison of run estimates by river as obtained from scale pattern analyses versus the standard method. For this report, the objectives were specific to the 1992 run.

METHODS

Catch and Escapement Estimation

Commercial catch statistics used in this report were computed from final operation reports prepared by fish processors (ADF&G 1993). The final ADF&G catch numbers may differ slightly from the numbers used in this report as minor errors are discovered and corrected. Sockeye salmon escapement estimates were based on visual counts made from towers on the banks of Kvichak, Naknek, Egegik, and Ugashik Rivers (ADF&G 1993).

Age Composition Estimation

European notation (Koo 1962) was used to record ages; numerals preceding the decimal refer to number of freshwater annuli, numerals following the decimal refer to number of marine annuli. Total age from time of egg deposition (brood year) is the sum of these numbers plus one. Complete methods and results of sampling Bristol Bay sockeye salmon catches and escapements have been summarized and published in separate reports (Stratton 1991; Stratton and Crawford 1992). The 1992 sampling efforts will be similarly reported.

Catch Composition Estimation

Linear discriminant function analysis (Fisher 1936) of scale patterns combined with age composition data were used to determine sockeye salmon stock origins in 1992 Eastside harvests. Sockeye salmon harvested from set gillnet catches in Naknek-Kvichak District were also sampled in 1992 and classified to river of origin.

Scale Measurements

Scale impressions were projected at 100X magnification onto a digitizing tablet using equipment similar to that described by Ryan and Christie (1976). Measurements were taken along the anterior-posterior axis to standardize each scale. This axis is approximately 20° ventral of the long axis and perpendicular to the anterior sculptured field (Figure 3). Distances between growth rings, or circuli, were measured to the nearest 0.01 in, and number of circuli were counted from (1) center of scale focus to outside edge of first freshwater annulus (first freshwater annular zone), (2) outside edge of first freshwater annulus to outside edge of second freshwater annulus (second freshwater annular zone), (3) outside edge of last freshwater annulus to end of freshwater growth (freshwater plus growth zone), if present, and (4) outside edge of last freshwater circulus to outer edge of first ocean annulus (first marine annular zone). Total distance from the outside edge of first ocean annulus to outside edge of second ocean annulus (second marine annular zone) was recorded for age-2.3 sockeye salmon. A total of 108 variables for age-2.2 samples and 109

variables for age-2.3 samples were computed from distance measurements and circuli counts (Appendix A.1).

Linear Discriminant Analysis

Escapement samples from Kvichak, Naknek, Egegik, and Ugashik Rivers provided known-origin scales to build linear discriminant functions (LDF). Commercial catch samples provided scales of unknown origin. Escapement samples collected in 1992 were used to classify 1992 commercial catches in age-specific LDF models.

Frequency distribution plots for principal scale variables for each growth zone were examined. Scale variable selection for each discriminant model was made using a forward stepping procedure with partial F -statistics as criteria for entry or removal of variables (Enslein et al. 1977). This process was continued until model accuracy ceased improving. The equality of variance-covariance matrices were tested using an F -statistic described by Box (1949). A nearly unbiased estimate of overall classification accuracy for each LDF was determined with a "leaving-one-out procedure" (Lachenbruch 1967).

Construction of Age-2.2 Models. A four-way linear discriminant model was built from scale measurements of age-2.2 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Scale samples weighted by run strength through time were used to build the discriminant models.

Classification of Age-2.2 Sockeye Salmon. The four-way linear discriminant model was used to assign unknown age-2.2 samples to river of origin. Stock proportions in the catches estimated from the model were adjusted for misclassification error with the procedure of Cook and Lord (1978). The adjusted proportions were assumed to reflect true stock composition. A catch sample was reclassified with a model containing fewer stocks if the adjusted proportion ≤ 0 for one or more stocks in the four-way model. Variance and 90% confidence intervals around adjusted estimates were computed using the procedure of Pella and Robertson (1979).

The number of age-2.2 sockeye salmon for stock i in a specific catch stratum, $\hat{C}_{i2.2}$ was calculated as

$$\hat{C}_{i2.2} = \hat{C} \hat{P}_{2.2} \hat{S}_{i2.2}, \quad (1)$$

where:

\hat{C} = estimated catch of sockeye salmon in a fishery at a given time,

$\hat{P}_{2.2}$ = estimated proportion of age-2.2 sockeye salmon in the catch, and

$\hat{S}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock i in the catch.

In this procedure, the variance about catch (\hat{C}) is not evaluated. Consequently, a conditional variance of the estimated age-2.2 sockeye salmon catch ($V[C_{i2.2}]$) for each stock in a specific fishery at a given time was calculated as described by Goodman (1960). This provided an exact variance of a product conditional on catch:

$$V[\hat{C}_{i2.2}] = C^2 V[\hat{P}_{2.2} \hat{S}_{i2.2}], \quad (2)$$

$$V[\hat{P}_{2.2} \hat{S}_{i2.2}] = V[\hat{P}_{2.2}] \hat{S}_{i2.2}^2 + V[\hat{S}_{i2.2}] \hat{P}_{2.2}^2 - V[\hat{S}_{i2.2}] V[\hat{P}_{2.2}]. \quad (3)$$

Contributions for each stock through time for a specific fishery were added to estimate total contribution to that fishery. The variance of the total contribution was calculated by summing the variances for each period. The contributions by stock to each fishery were added to produce the total contribution by stock to the Eastside age-2.2 sockeye salmon harvest. The variance of the total contribution by stock was calculated as the sum of the variances for each fishery.

Construction of Age-2.3 Models. A four-way linear discriminant model was built from scale measurements of age-2.3 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Scale samples weighted by run strength through time were used to build the discriminant models. Frequency distribution plots of the total size of first and second freshwater growth zones for Kvichak and Naknek River stocks were similar (Figure 4). Therefore, all Kvichak and Naknek River samples were pooled. A three-way linear discriminant model was built using scales from Egegik, Ugashik, and Kvichak/Naknek Rivers pooled.

Classification of Age-2.3 Sockeye Salmon. The three-way linear discriminant model was used to classify 1992 district catches of age-2.3 sockeye salmon. A catch sample was reclassified with a two-way model if the adjusted proportion was ≤ 0 for one of the stocks in the three-way model. Procedures for the age-2.3 analysis were the same as those used for the age-2.2 analysis.

Separation of Kvichak/Naknek Age-2.3 Catch

The age-2.3 sockeye salmon catch proportion classified to the Kvichak/Naknek group was separated to each river based on age composition of the escapements:

$$\hat{S}_{i2.3} = \hat{S}_{p2.3} \frac{\hat{E}_{i2.3}}{\hat{E}_{p2.3}}, \quad (4)$$

where: $\hat{S}_{p2.3}$

= estimated proportion of age-2.3 sockeye salmon of Kvichak/Naknek pooled stocks in the catch, and

$\hat{E}_{p2.3}$ = estimated number of age-2.3 sockeye salmon in Kvichak and Naknek River pooled escapement.

Other Age Group Stock Composition Estimation

Estimates of stock composition for sockeye salmon of other ages harvested in Eastside districts were based on scale pattern estimates for age-2.2 and -2.3 sockeye salmon, and the ratio of age-2.2 and -2.3 sockeye salmon to sockeye salmon of other age groups within the respective escapements:

$$\hat{S}_{ij} = \frac{\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}}}{\sum_{i=1}^n \left(\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}} \right)}, \quad (5)$$

$$\hat{S}_{i(2.2,2.3)} = \frac{\hat{C}_{i2.2} + \hat{C}_{i2.3}}{\hat{C}_{2.2} + \hat{C}_{2.3}}, \quad \text{and} \quad (6)$$

$$\hat{T}_{i(2.2,2.3)} = \frac{\hat{E}_{i2.2} + \hat{E}_{i2.3}}{\hat{E}_i}, \quad (7)$$

where:

\hat{T}_{ij} = estimated proportion of age j sockeye salmon in stock i escapement,

$\hat{T}_{i(2.2,2.3)}$ = estimated proportion of combined age-2.2 and age-2.3 sockeye salmon of stock i in the escapement,

$\hat{S}_{i(2.2,2.3)}$ = estimated proportion of combined age-2.2 and age-2.3 sockeye salmon of stock i in the catch,

$\hat{C}_{i2.2}$ = estimated number of age-2.2 sockeye salmon of stock i in the catch,

$\hat{C}_{i2.3}$ = estimated number of age-2.3 sockeye salmon of stock i in the catch,

$\hat{C}_{2.2}$ = estimated number of age-2.2 sockeye salmon in the catch,

$\hat{C}_{2.3}$ = estimated number of age-2.3 sockeye salmon in the catch,

$\hat{E}_{i2.2}$ = estimated number of age-2.2 sockeye salmon in stock i escapement,

$\hat{E}_{i2.3}$ = estimated number of age-2.3 sockeye salmon in stock i escapement, and

\hat{E}_i = estimated number of stock i escapement.

Run Size Estimation

Sockeye salmon run size to each river was estimated by adding estimates of catch by stock to escapement estimates. For each river, we computed the percentage (1) harvested within the natal district, (2) harvested outside the natal district, and (3) that escaped. Finally, run size estimates from scale pattern analysis were compared with estimates from the standard method.

RESULTS

Catch and Escapement

Eastside commercial fishermen harvested an estimated 28,361,994 sockeye salmon in 1992 (Table 1). This was 44% greater than the 1982–91 average catch of 19.7 million. The 15,677,236 sockeye salmon caught in Egegik District accounted for 55.3% of the Eastside harvest; commercial harvests in Naknek-Kvichak were 9,329,663 or 32.9% of the Eastside harvest and in Ugashik were 3,355,095 or 11.8%.

Sockeye salmon escapements in 1992 were estimated to be 4,725,864 in Kvichak River, 1,606,650 in Naknek River, 1,945,632 in Egegik District, and 2,194,927 in Ugashik District (Table 2).

Age Composition

Four age groups made up 98.0% of the Eastside sockeye salmon catch: age-1.2 was 5.7%, age-1.3 was 26.9%, age-2.2 was 38.0%, and age-2.3 was 27.4% (Table 3). Naknek-Kvichak District catch was 30.3% age-2.3, 27.5% age-1.3, and 27.0% age-2.2. Egegik District catch was 46.2% age-2.2. Ugashik District catch was 31.6% age-2.3, 31.1% age-1.3, and 30.4% age-2.2.

Age composition of sockeye salmon escapements also varied among runs (Table 4). Kvichak River escapement was 44.2% age-2.2 and 31.7% age-1.2 sockeye salmon. Naknek River escapement was 43.3% age-2.3 and 23.0% age-1.3. Egegik River escapement was 60.1% age-2.2. Ugashik River escapement was 34.8% age-2.2, 26.5% age-2.3, and 23.4% age-1.3.

Classification Models

Age 2.2

Scale characteristics which differed the most among age-2.2 sockeye salmon stocks were variables 66, 35, and 8 (Tables 5, 6). In general, freshwater growth was greatest in Egegik River, followed by Ugashik, Naknek, and Kvichak Rivers (Figure 5).

Estimated overall classification accuracy for the four-way model was 70.1% (Table 6). Individual classification accuracy was highest for Egegik (82.0%), similar for Naknek (70.4%) and Kvichak (66.5%), and lowest for Ugashik (61.5%) River. The range of overall classification accuracies were 69.2% to 80.5% for three-way models and 82.8% to 92.7% for two-way models.

Age 2.3

Scale variables were similar between Kvichak and Naknek samples; the four-way model could not accurately differentiate between these stocks (Tables 7, 8; Figure 4). Egegik stocks were distinct (Figure 6). Therefore, Kvichak and Naknek samples were pooled and compared to Egegik and Ugashik River samples in a three-way model. Scale measurements that provided the greatest discrimination among age-2.3 sockeye salmon in the three-way model were variables 64, 12, and 42 (Tables 7, 8).

Estimated overall classification accuracy for the three-way model was 74.3% (Table 8). Individual classification accuracy was similar for Ugashik (77.4%) and Egegik (76.3%), and lower for Kvichak/Naknek combined (69.1%). The range of overall classification accuracies was 85.2% to 92.3% for two-way models.

Estimates of Catch Composition

Age 2.2

Of the estimated 2,520,101 age-2.2 sockeye salmon caught in Naknek-Kvichak District, 76.6% originated within the district and 23.4% from outside the district (Figure 7). Of the estimated 7,236,919 age-2.2 sockeye salmon caught in Egegik District, 89.2% originated from Egegik River and 10.8% were produced outside the district (Figure 8). The estimated catch of age-2.2 sockeye salmon in Ugashik District was 1,021,058; 90.5% originated in Ugashik River and 9.5% from outside the district (Figure 9). The 90% confidence intervals by group are presented in Tables 9 and 10.

Age 2.3

Of the estimated 2,828,880 age-2.3 sockeye salmon caught in Naknek-Kvichak District, 65.3% originated within the district and 34.7% from outside the district (Figure 10). Of the estimated 3,876,070 age-2.3

sockeye salmon caught in Egegik District, 83.9% originated from Egegik River and 16.1% were produced outside the district (Figure 11). The estimated catch of age-2.3 sockeye salmon in Ugashik District was 1,059,557; 81.1% originated in Ugashik River and 18.9% from stocks outside the district (Figure 12). The 90% confidence intervals by group are presented in Tables 11 and 12.

All Ages

The Naknek-Kvichak District harvest was composed of an estimated 3,886,321 sockeye salmon from Kvichak River, 3,074,783 from Naknek River, 1,307,727 from Egegik River, and 1,060,832 from Ugashik River (Table 13). Estimated stock contributions to the Naknek-Kvichak District total catch were 41.7% for Kvichak, 33.0% for Naknek, 14.0% for Egegik, and 11.3% for Ugashik Rivers (Figure 13). Stock composition of setnet harvests in Kvichak Section differed greatly (NSC = nonstatistical comparison) from setnet harvests in Naknek Section (Table 14). Kvichak River sockeye salmon were the largest component of Kvichak Section setnet catches (78.9%), whereas Naknek River sockeye salmon were the largest component of Naknek Section setnet catches (76.6%).

Of the sockeye salmon caught in Egegik District, an estimated 13,077,570 were from Egegik River, 1,151,896 from Naknek River, 1,019,623 from Ugashik River, and 428,147 from Kvichak River (Table 15). Estimated stock contributions to the Egegik District total catch were 83.5% Egegik, 7.3% Naknek, 6.5% Ugashik, and 2.7% Kvichak Rivers (Figure 14).

The Ugashik District catch was composed of an estimated 2,888,462 sockeye salmon from Ugashik River, 203,496 from Egegik River, 173,366 from Naknek River, and 89,771 from Kvichak River (Table 16). Estimated stock contribution to the total Ugashik District sockeye salmon catch were 86.1% from Ugashik River, 6.1% from Egegik River, 5.2% from Naknek River, and 2.6% from Kvichak River (Figure 15).

Harvest Distribution

Of the estimated 4,404,239 Kvichak River sockeye salmon harvested in 1992, 88.3% were taken in Naknek-Kvichak, 9.7% in Egegik, and 2.0% in Ugashik Districts (Table 17). Of the estimated 4,400,045 Naknek River sockeye salmon harvested, 69.9% were taken in Naknek-Kvichak, 26.2% in Egegik, and 3.9% in Ugashik Districts. Of the estimated 14,588,793 Egegik River sockeye salmon harvested, 89.6% were taken in Egegik, 9.0% in Naknek-Kvichak, and 1.4% in Ugashik Districts. Of the estimated 4,968,917 Ugashik River sockeye salmon harvested, 58.1% were taken in Ugashik, 21.4% in Naknek-Kvichak, and 20.5% in Egegik Districts.

An estimated 1,843,180 sockeye salmon destined for Kvichak and Naknek Rivers were harvested outside their natal district, whereas Naknek-Kvichak District fishermen caught 2,368,559 sockeye salmon bound for other districts. Therefore, Naknek-Kvichak District fishermen realized a net gain of 525,379 sockeye salmon. The number of Egegik River sockeye salmon harvested in other districts was 1,511,223, whereas fishermen in Egegik District caught 2,599,666 sockeye salmon bound for other districts. Therefore,

Egegik District fishermen realized a net gain of 1,088,443 sockeye salmon. An estimated 2,080,455 Ugashik River sockeye salmon were harvested outside Ugashik District, whereas 466,633 sockeye salmon from other rivers were caught in Ugashik District. Therefore, Ugashik District fishermen had a net loss of 1,613,822 sockeye salmon.

Run By River System

Run Distribution

The 1992 Kvichak River run was estimated to be 9,130,103 sockeye salmon: 51.7% escaped, 42.6% were harvested in Naknek-Kvichak District, and 5.7% were harvested in other districts (Tables 18, 19; Figure 16). The 1992 Naknek River run was estimated to be 6,006,695 sockeye salmon: 26.7% escaped, 51.2% were harvested in Naknek-Kvichak District, and 22.1% were harvested in other districts (Figure 17). The 1992 Egegik River run was estimated to be 16,534,425 sockeye salmon: 11.8% escaped, 79.1% were harvested in Egegik District, and 9.1% were harvested in other districts (Figure 18). The 1992 Ugashik River run was estimated to be 7,163,844: 30.7% escaped, 40.3% were harvested in Ugashik District, and 29.0% were harvested in other districts (Figure 19).

Exploitation Rates

The Ugashik River run was exploited outside the natal district at a 29.0% rate, slightly higher than Naknek River's run (22.1%). Egegik (9.1%) and Kvichak (5.7%) Rivers were exploited outside their natal district at much lower rates. Total exploitation rates based on harvests inside and outside the natal district were 48.3% for Kvichak River, 69.3% for Ugashik River, 73.3% for Naknek River, and 88.2% for Egegik River (Tables 18, 19; Figures 16-19).

Comparison of Run Estimates

Run estimates based on the standard method cannot be directly compared to those based on scale pattern analysis because Branch River stock was not included in linear discriminant models. Therefore, standard run estimates were adjusted so that Naknek-Kvichak District catch was only divided between Kvichak and Naknek Rivers. Ugashik River had the greatest difference in estimated run size between the two methods (Table 20). The standard method estimate for the Ugashik River run was 1,613,822 sockeye salmon less than that obtained from scale pattern analysis. Estimates for Kvichak River differed by 1,479,669, the standard method estimate being higher. Estimates for Egegik River differed by 1,088,443, the standard method estimate again being higher. The standard method estimate of run size for Naknek River was 954,290 lower than that obtained from scale pattern analysis. Harvests of stocks outside their natal districts in 1992 resulted in the standard method over-estimating runs to Kvichak (13.9%) and Egegik Rivers (6.2%) and under-estimating runs to Naknek (-18.9%) and Ugashik (-29.1%) Rivers.

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Table 1. Sockeye salmon commercial catch by district and date for the Eastside of Bristol Bay, 1992.

Date	Catch by District ^a			Total
	Naknek-Kvichak	Egegik	Ugashik	
6/08-6/12	151		27	178
6/15-6/19	40,069		15,507	55,576
6/21		42 ^b		42
6/22	75,317		5,695	81,012
6/23	26,700	404,307	1,445	432,452
6/24	1,350 ^b	78 ^b		1,428
6/25	1,602 ^b	716,853		718,455
6/26	3,873 ^b			3,873
6/27-6/30	781,089	1,634,596	67,862	2,483,537
7/01	3,271 ^b	723,064	1,039 ^b	727,374
7/02	3,589 ^b	671,016	516 ^b	675,121
7/03	273,498	1,224,412	659 ^b	1,498,569
7/04	638,525	1,136,522	639 ^b	1,775,686
7/05	1,716,031	1,206,132	223 ^b	2,922,386
7/06	589,008	847,391	141,430	1,577,829
7/07	517,170	750,392		1,267,562
7/08	465,916	733,214	553 ^b	1,199,683
7/09	807,337	715,799	461,018	1,984,154
7/10	772,862	1,430,790	115 ^b	2,203,767
7/11	379,942	774,802	199 ^b	1,154,943
7/12	351,467	373,314	886 ^b	725,667
7/13	293,841	451,563	2,195 ^b	747,599
7/14	513,257	434,188	827,671	1,775,116
7/15	306,849	434,302	642,025	1,383,176
7/16	265,280	511,348	298,296	1,074,924
7/17	205,381	186,943	262,976	655,300
7/18	76,338	99,855	181,329	357,522
7/19	61,699	57,711	142,763	262,173
7/20-7/24	131,707	129,127	248,245	509,079
7/27-7/31	22,769	25,194	46,220	94,183
8/03-8/07	3,192	3,440	3,580	10,212
8/10-8/14	500	796	1,731	3,027
8/17-8/21	83	37	223	343
8/24-8/28		8	36	44
8/31-9/01			2	2
Total	9,329,663	15,677,236	3,355,095	28,361,994
Percent	32.9	55.3	11.8	100.0

^a Blanks indicate a district was closed.

^b ADF&G test-fish catch

Table 2. Sockeye salmon escapement by river and date for the Eastside of Bristol Bay, 1992.

Date	Kvichak River		Naknek River		Egegik River		Ugashik River	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
6/20			672	672	1,656	1,656		
6/21			1,230	1,902	9,864	11,520		
6/22	0	0	1,794	3,696	3,204	14,724		
6/23	450	450	2,586	6,282	14,304	29,028		
6/24	768	1,218	8,904	15,186	15,060	44,088		
6/25	1,260	2,478	12,510	27,696	22,032	66,120		
6/26	7,080	9,558	43,200	70,896	41,142	107,262		
6/27	6,966	16,524	109,140	180,036	118,674	225,936		
6/28	64,962	81,486	8,082	188,118	96,294	322,230		
6/29	173,922	255,408	12,612	200,730	130,620	452,850		
6/30	191,496	446,904	49,128	249,858	129,990	582,840		
7/01	188,556	635,460	10,476	260,334	144,366	727,206		
7/02	119,406	754,866	69,774	330,108	45,798	773,004		
7/03	43,926	798,792	365,112	695,220	7,692	780,696	762	762
7/04	294,666	1,093,458	242,454	937,674	11,232	791,928	948	1,710
7/05	569,814	1,663,272	135,642	1,073,316	53,580	845,508	678	2,388
7/06	581,130	2,244,402	41,898	1,115,214	84,240	929,748	426	2,814
7/07	443,604	2,688,006	21,624	1,136,838	114,972	1,044,720	924	3,738
7/08	191,712	2,879,718	11,166	1,148,004	89,574	1,134,294	894	4,632
7/09	79,872	2,959,590	12,138	1,160,142	109,764	1,244,058	942	5,574
7/10	25,212	2,984,802	57,594	1,217,736	155,604	1,399,662	834	6,408
7/11	190,398	3,175,200	128,148	1,345,884	146,322	1,545,984	798	7,206
7/12	486,966	3,662,166	91,494	1,437,378	141,642	1,687,626	3,066	10,272
7/13	404,100	4,066,266	65,136	1,502,514	83,292	1,770,918	9,426	19,698
7/14	263,544	4,329,810	56,784	1,559,298	24,624	1,795,542	65,730	85,428
7/15	107,964	4,437,774	10,866	1,570,164	19,812	1,815,354	401,778	487,206
7/16	78,714	4,516,488	10,650	1,580,814	23,220	1,838,574	529,362	1,016,568
7/17	61,158	4,577,646	7,140	1,587,954	30,378	1,868,952	548,964	1,565,532
7/18	47,760	4,625,406	5,892	1,593,846	18,198	1,887,150	348,852	1,914,384
7/19	37,566	4,662,972	5,094	1,598,940	24,936	1,912,086	44,154	1,958,538
7/20	23,856	4,686,828	5,172	1,604,112	24,384	1,936,470	38,520	1,997,058
7/21	22,806	4,709,634	2,538	1,606,650	8,862	1,945,332	17,322	2,014,380
7/22	8,556	4,718,190					8,082	2,022,462
7/23	5,262	4,723,452					6,156	2,028,618
7/24	2,412	4,725,864					16,158	2,044,776
7/25							21,426	2,066,202
7/26							58,248	2,124,450
7/27							25,002	2,149,452
7/28							18,324	2,167,776
7/29							5,916	2,173,692
Total	4,725,864		1,606,650		1,945,332 ^a		2,173,692 ^b	

^a An additional 300 sockeye salmon were counted in King Salmon River tributaries, bringing the Egegik District sockeye salmon escapement total to 1,945,632.

^b An additional 7,810 and 13,425 sockeye salmon were counted in Dog Salmon and King Salmon Rivers, bringing the Ugashik District sockeye salmon escapement total to 2,194,927.

Table 3. Sockeye salmon age composition by brood year in the commercial catch for the Eastside of Bristol Bay, 1992.

District	Sample Size		1989		1988			1987			1986			1985		Total
			0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	
Naknek-Kvichak	6,683	Numbers	696	528	4,634	1,097,410	7,212	155	2,566,256	2,520,101	255,626	2,828,880	2,675	36,412	9,078	9,329,663
		Percent	0.0*	0.0	0.1	11.8	0.1	0.0	27.5	27.0	2.7	30.3	0.0	0.4	0.1	100.0
Egegik	5,815	Numbers	1,436			352,799	12,819		4,019,311	7,236,919	86,892	3,876,070	73,074		17,916	15,677,236
		Percent	0.0			2.2	0.1		25.6	46.2	0.6	24.7	0.5		0.1	100.0
Ugashik	2,436	Numbers				162,962			1,041,710	1,021,058	60,931	1,059,557	3,628	5,249		3,355,095
		Percent				4.9			31.1	30.4	1.8	31.6	0.1	0.2		100.0
Total	14,934	Numbers	2,132	528	4,634	1,613,171	20,031	155	7,627,277	10,778,078	403,449	7,764,507	79,377	41,661	26,994	28,361,994
		Percent	0.0	0.0	0.0	5.7	0.1	0.0	26.9	38.0	1.4	27.4	0.3	0.1	0.0	100.0

^a Represented <0.1%

Table 4. Sockeye salmon age composition by brood year in the escapement for the Eastside of Bristol Bay, 1992.

River	Sample Size		1989		1988			1987				1986			1985		Total
			0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.4	1.4	2.3	3.2	2.4	3.3	
Kvichak	3,034	Numbers Percent	27,689 0.6	1,633 0.0*	12,694 0.3	1,498,169 31.7	14,504 0.3	3,731 0.1	744,718 15.8	2,088,448 44.2		6,378 0.1	324,088 6.9		2,712 0.1	1,100 0.0	4,725,864 100.0
Naknek	1,692	Numbers Percent		710 0.0		157,348 9.8	10,186 0.6	522 0.0	368,951 23.0	253,544 15.8		112,584 7.0	696,183 43.3		4,289 0.3	2,333 0.2	1,606,650 100.0
Egegik	3,167	Numbers Percent			405 0.0	49,546 2.6	49,511 2.5		322,333 16.6	1,169,346 60.1	3,093 0.2	1,983 0.1	335,192 17.2	13,519 0.7		704 0.0	1,945,632 ^b 100.0
Ugashik	2,642	Numbers Percent	2,575 0.1	7,333 0.3	1,164 0.1	289,013 13.2	26,666 1.2		514,078 23.4	764,065 34.8		8,605 0.4	580,615 26.5	813 0.0			2,194,927 ^c 100.0

^a Represented <0.1%

^b Includes 300 sockeye salmon counted in King Salmon River tributaries.

^c Includes 21,235 sockeye salmon counted in Dog Salmon and King Salmon River tributaries.

Table 5. Mean and standard error of age-2.2 scale variables used to construct linear discriminant functions for the Eastside of Bristol Bay, 1992.

Variable		Kvichak		Naknek		Egegik		Ugashik	
Number	Name	Mean ^a	SE	Mean	SE	Mean	SE	Mean	SE
<u>First Freshwater Annular Zone</u>									
1	NC1FW	10.11	0.095	10.47	0.125	12.46	0.136	10.27	0.095
2	S1FW	133.70	1.041	130.49	1.396	157.15	1.679	126.98	1.163
5	C0-C6	98.37	0.502	93.33	0.621	98.21	0.518	92.40	0.567
6	C0-C8	117.53	0.572	112.31	0.732	118.35	0.619	110.08	0.653
8	C2-C6	50.16	0.401	45.78	0.403	48.61	0.333	44.70	0.382
9	C2-C8	69.39	0.479	64.66	0.527	68.71	0.447	62.32	0.484
10	C4-C6	23.67	0.227	20.67	0.252	22.44	0.207	20.81	0.218
12	C(NC-4)-E1FW	34.34	0.310	32.50	0.305	33.57	0.267	32.05	0.279
23	C4-C6/S1FW	0.18	0.001	0.16	0.002	0.15	0.002	0.17	0.002
24	C4-C8/S1FW	0.32	0.002	0.30	0.002	0.27	0.002	0.30	0.002
25	(C(NC-4)-E1FW)/S1FW	0.26	0.003	0.26	0.004	0.22	0.003	0.26	0.003
27	S1FW/NC1FW	13.30	0.074	12.54	0.078	12.65	0.059	12.40	0.065
<u>Second Freshwater Annular Zone</u>									
34	E1FW-C4	50.40	0.353	44.69	0.382	48.05	0.309	51.10	0.379
35	E1FW-C6	72.42	0.456	63.74	0.498	71.84	0.374	74.21	0.467
38	C2-C6	47.50	0.368	40.56	0.394	48.29	0.279	48.89	0.398
40	C4-C6	22.02	0.246	19.04	0.234	23.79	0.193	23.11	0.241
42	C(NC-4)-E2FW	35.27	0.328	32.91	0.307	37.71	0.328	35.69	0.360
45	C4-E2FW	45.72	0.863	41.78	0.956	56.63	1.006	48.77	0.874
46	(E1FW-C2)/S2FW	0.26	0.003	0.27	0.004	0.23	0.003	0.26	0.003
56	(C(NC-2)-E2FW)/S2FW	0.16	0.002	0.18	0.003	0.15	0.002	0.16	0.002
57	S2FW/NC2FW	10.81	0.062	9.75	0.067	10.94	0.054	11.01	0.066
<u>Freshwater and Plus Growth Zones</u>									
63	NC1FW+NC2FW	19.01	0.111	19.34	0.134	22.04	0.118	19.38	0.115
64	S1FW+S2FW	229.82	1.201	216.96	1.598	261.82	1.506	226.85	1.416
65	NC1FW+NC2FW+NCPG	20.02	0.100	20.39	0.132	23.13	0.116	20.86	0.116
66	S1FW+S2FW+SPGZ	239.47	1.138	227.08	1.554	272.80	1.443	242.50	1.380
67	S1FW/S1FW+S2FW+SPGZ	0.56	0.003	0.57	0.004	0.57	0.004	0.52	0.003
<u>First Marine Annular Zone</u>									
70	NC1OZ	22.21	0.136	21.12	0.163	21.99	0.144	22.21	0.138
71	S1OZ	412.60	2.432	393.54	3.019	397.87	2.818	411.39	2.681
84	C9-C15	119.37	0.714	117.15	0.900	112.99	0.744	121.52	0.837
87	C3-E1OZ	354.27	2.430	336.49	3.028	340.08	2.805	356.84	2.684
93	(E1FW-C12)/S1OZ	0.62	0.004	0.65	0.005	0.64	0.004	0.62	0.004
97	(C3-C12)/S1OZ	0.48	0.003	0.50	0.004	0.49	0.003	0.48	0.003
103	(C(NC-6)-E1OZ)/S1OZ	0.20	0.002	0.22	0.003	0.20	0.002	0.20	0.002
105	S1OZ/NC1OZ	18.62	0.082	18.68	0.091	18.12	0.083	18.55	0.077

^a Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 6. Classification matrices from discriminant analyses of age-2.2 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1992.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	200	<u>66.5</u>	13.5	5.5	14.5
Naknek	189	11.1	<u>70.4</u>	7.4	11.1
Egegik	200	6.5	4.0	<u>82.0</u>	7.5
Ugashik	200	17.0	14.5	7.0	<u>61.5</u>

Mean classification accuracy = 70.1%

Variables used: 66, 35, 8, 64, 105, 42, 23, 25, 97, 27, 5, 56

Box's Test of Variance-Covariance Equality^a

F-statistic = 2.26

df = 234, 1,313,142

P = 0.016

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>
Kvichak	200	<u>78.5</u>	14.0	7.5
Naknek	189	12.7	<u>79.9</u>	7.4
Egegik	200	11.0	6.0	<u>83.0</u>

Mean classification accuracy = 80.5%

Variables used: 66, 35, 10, 105, 38, 42, 8, 103, 56

Box's Test of Variance-Covariance Equality

F-statistic = 2.02

df = 90, 935,852

P = 0.000

-Continued-

Table 6. (p 2 of 5).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Naknek</u>	<u>Ugashik</u>
Kvichak	200	<u>64.5</u>	17.0	18.5
Naknek	189	13.2	<u>72.5</u>	14.3
Ugashik	200	16.5	13.0	<u>70.5</u>

Mean classification accuracy = 69.2%
 Variables used: 35, 8, 27, 23, 66, 64, 5, 93, 70
 Box's Test of Variance-Covariance Equality
 F-statistic = 1.80
 df = 90, 935,852
 P = 0.006

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	198	<u>76.3</u>	5.6	18.2
Egegik	199	7.5	<u>80.9</u>	11.6
Ugashik	198	23.2	6.6	<u>70.2</u>

Mean classification accuracy = 75.8%
 Variables used: 9, 42, 63, 71, 27, 57, 84, 6, 2, 67, 56, 45, 40
 Box's Test of Variance-Covariance Equality
 F-statistic = 4.34
 df = 182, 928,886
 P = 0.003

-Continued-

Table 6. (p 3 of 5).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Naknek	189	<u>79.4</u>	6.9	13.8
Egegik	200	6.0	<u>82.5</u>	11.5
Ugashik	200	17.0	8.5	<u>74.5</u>

Mean classification accuracy = 78.8%
 Variables used: 66, 35, 64, 105, 40, 97, 57, 56, 12, 23
 Box's Test of Variance-Covariance Equality
 F-statistic = 2.21
 df = 110, 924,635
 P = 0.000

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Naknek</u>
Kvichak	200	<u>80.5</u>	19.5
Naknek	189	14.8	<u>85.2</u>

Mean classification accuracy = 82.8%
 Variables used: 38, 10, 70, 87, 46, 1
 Box's Test of Variance-Covariance Equality
 F-statistic = 2.64
 df = 21, 547,153
 P = 0.002

-Continued-

Table 6. (p 4 of 5).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Egegik</u>
Kvichak	198	<u>92.9</u>	7.1
Egegik	199	12.1	<u>87.9</u>

Mean classification accuracy = 90.4%
 Variables used: 65, 42, 71, 56, 24
 Box's Test of Variance-Covariance Equality
 F-statistic = 3.77
 D.F. = 15, 628,172
 P = 0.002

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Naknek</u>	<u>Egegik</u>
Naknek	189	<u>90.5</u>	9.5
Egegik	200	5.0	<u>95.0</u>

Mean classification accuracy = 92.7%
 Variables used: 66, 105, 38, 42, 56
 Box's Test of Variance-Covariance Equality
 F-statistic = 3.24
 df = 15, 598,869
 P = 0.000

-Continued-

Table 6. (p 5 of 5).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Egegik</u>	<u>Ugashik</u>
Egegik	200	<u>88.0</u>	12.0
Ugashik	200	11.5	<u>88.5</u>

Mean classification accuracy = 88.2%
 Variables used: 64, 34, 71, 40, 42, 56
 Box's Test of Variance-Covariance Equality
 F-statistic = 3.19
 D.F. = 21, 582,609
 P = 0.000

^a The equality of the variance-covariance matrices tested
 with a procedure described by Box (1949).

Table 7. Mean and standard error of age-2.3 scale variables used to construct linear discriminant functions for the Eastside of Bristol Bay, 1992.

Variable		Kvichak		Naknek		Egegik		Ugashik	
Number	Name	Mean ^a	SE	Mean	SE	Mean	SE	Mean	SE
<u>First Freshwater Annular Zone</u>									
2	S1FW	135.65	1.726	131.75	2.193	162.88	1.864	121.69	1.063
5	C0-C6	93.44	0.849	95.24	0.999	100.08	0.630	90.53	0.562
8	C2-C6	46.96	0.525	46.21	0.630	49.88	0.406	42.60	0.348
12	C(NC-4)-E1FW	34.66	0.413	33.54	0.426	34.17	0.293	30.97	0.241
14	C2-E1FW	89.17	1.772	82.72	2.052	112.68	1.833	73.76	0.951
18	C0-C6/S1FW	0.70	0.010	0.74	0.010	0.63	0.007	0.75	0.005
21	C2-C6/S1FW	0.35	0.005	0.36	0.004	0.31	0.004	0.35	0.003
22	C2-C8/S1FW	0.49	0.005	0.49	0.004	0.43	0.004	0.49	0.003
25	(C(NC-4)-E1FW)/S1FW	0.26	0.006	0.26	0.006	0.22	0.003	0.26	0.003
27	S1FW/NC1FW	12.76	0.120	12.94	0.118	12.78	0.072	12.16	0.067
<u>Second Freshwater Annular Zone</u>									
31	NC2FW	9.64	0.142	10.30	0.159	10.13	0.095	9.77	0.082
32	S2FW	102.82	1.503	104.20	1.726	110.42	1.134	104.79	0.897
34	E1FW-C4	50.29	0.499	46.79	0.429	47.54	0.374	50.81	0.396
35	E1FW-C6	72.07	0.699	67.62	0.610	71.26	0.515	73.42	0.458
41	C4-C8	40.12	0.549	39.42	0.507	45.33	0.411	41.01	0.370
42	C(NC-4)-E2FW	34.90	0.528	33.35	0.384	37.74	0.354	33.88	0.312
47	E1FW-C4/S2FW	0.50	0.007	0.46	0.008	0.44	0.005	0.49	0.005
54	C4-C8/S2FW	0.39	0.004	0.38	0.004	0.41	0.003	0.39	0.003
55	(C(NC-4)-E2FW)/S2FW	0.35	0.007	0.33	0.007	0.35	0.005	0.33	0.004
56	(C(NC-2)-E2FW)/S2FW	0.16	0.004	0.15	0.003	0.15	0.002	0.14	0.002
57	S2FW/NC2FW	10.71	0.098	10.12	0.071	10.92	0.064	10.76	0.063
58	NC 1ST 3/4	6.03	0.097	6.55	0.121	6.47	0.073	6.02	0.063
<u>Freshwater and Plus Growth Zones</u>									
64	S1FW+S2FW	238.47	2.014	235.95	2.433	273.30	2.065	226.47	1.215
66	S1FW+S2FW+SPGZ	249.23	2.111	249.85	2.313	284.19	1.982	238.78	1.250
<u>First Marine Annular Zone</u>									
71	S10Z	398.33	4.524	400.28	4.015	389.19	2.681	395.43	2.492
76	EFW-C15	312.35	2.293	312.79	2.063	306.70	1.399	306.23	1.374
85	C(NC-6)-E10Z	80.88	0.939	79.62	0.964	74.87	0.636	78.99	0.599
105	S10Z/NC10Z	18.65	0.124	18.61	0.122	18.07	0.084	18.17	0.076
107	MAX DIST	29.65	0.339	29.46	0.329	29.08	0.250	28.53	0.221

^a Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 8. Classification matrices from discriminant analyses of age-2.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1992.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	97	<u>56.7</u>	22.7	5.2	15.5
Naknek	97	20.6	<u>54.6</u>	6.2	18.6
Egegik	100	8.0	16.0	<u>70.0</u>	6.0
Ugashik	97	17.5	10.3	1.0	<u>71.1</u>

Mean classification accuracy = 63.1%

Variables used: 64, 34, 12, 42, 18, 41, 105, 14, 8, 66

Box's Test of Variance-Covariance Equality^a

F-statistic = 3.18

df = 234, 324, 320

P = 0.001

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak/Naknek^b</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak/Naknek	194	<u>69.1</u>	11.3	19.6
Egegik	198	17.2	<u>76.3</u>	6.6
Ugashik	195	21.0	1.5	<u>77.4</u>

Mean classification accuracy = 74.3%

Variables used: 64, 12, 42, 57, 105, 56, 21, 54, 25, 32

Box's Test of Variance-Covariance Equality

F-statistic = 4.99

df = 110, 922, 628

P = 0.020

-Continued-

Table 8. (p 2 of 2).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak/Naknek</u>	<u>Egegik</u>
Kvichak/Naknek	194	<u>89.7</u>	10.3
Egegik	198	19.2	<u>80.8</u>

Mean classification accuracy = 85.2%
 Variables used: 64, 54, 76, 42, 57, 18, 5, 85, 107
 Box's Test of Variance-Covariance Equality
 F-statistic = 2.37
 df = 45, 449,248
 P = 0.007

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Egegik</u>	<u>Ugashik</u>
Egegik	196	<u>90.3</u>	9.7
Ugashik	196	5.6	<u>94.4</u>

Mean classification accuracy = 92.3%
 Variables used: 2, 47, 55, 71, 58, 22
 Box's Test of Variance-Covariance Equality
 F-statistic = 4.69
 df = 21, 559,424
 P = 0.000

^a The equality of the variance-covariance matrices tested with a procedure described by Box (1949).

^b Kvichak and Naknek Rivers combined.

Table 9. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.2 sockeye salmon by fishery and date for the Eastside of Bristol Bay, 1992.

District	Date	Kvichak		Naknek		Egegik		Ugashik	
		Percent	90% C.I.	Percent	90% C.I.	Percent	90% C.I.	Percent	90% C.I.
Naknek-Kvichak	6/09-6/26	96.3	(75.9,100)	0.0	Trace ^a	3.3	(0.0,12.3)	0.4	(0.0,19.6)
	6/27-6/28	78.1	(48.2,100)	11.8	(0.0,33.6)	2.8	(0.0,14.0)	7.3	(0.0,32.2)
	6/29	97.7	(85.4,100)	2.3	(0.0,14.6)	0.0	Trace	0.0	Trace
	6/30-7/02	87.5	(70.3,100)	4.7	(0.0,18.7)	7.8	(0.0,18.7)	0.0	Trace
	7/03	61.0	(42.6,79.3)	38.5	(20.8,56.2)	0.5	(0.0,9.5)	0.0	Trace
	7/04-7/07	72.3	(46.2,98.4)	6.5	(0.0,24.2)	13.4	(0.7,26.1)	7.8	(0.0,29.4)
	7/08-7/09	51.7	(33.8,69.6)	10.6	(0.0,24.2)	37.7	(22.7,52.7)	0.0	Trace
	7/10-7/11	65.3	(38.1,92.7)	9.7	(0.0,28.9)	10.1	(0.0,22.7)	14.9	(0.0,38.8)
	7/12	65.8	(39.4,92.2)	14.3	(0.0,33.8)	13.4	(0.3,26.5)	6.5	(0.0,28.1)
	7/13-7/14	42.6	(18.9,66.3)	37.3	(15.6,58.9)	8.7	(0.0,20.3)	11.4	(0.0,32.4)
	7/15-8/18	23.0	(0.0,50.6)	22.9	(0.0,47.8)	23.8	(4.5,43.0)	30.3	(0.1,60.5)
Egegik	6/21-6/25	16.7	(1.7,31.7)	0.0	Trace	75.7	(60.4,90.9)	7.6	(0.0,23.8)
	6/27-6/29	23.0	(3.4,43.1)	0.4	(0.0,12.7)	61.7	(44.3,79.3)	14.6	(0.0,34.4)
	6/30	0.0	Trace	0.0	Trace	97.4	(88.5,100)	2.6	(0.0,11.5)
	7/01-7/04	0.0	Trace	11.0	(0.0,22.9)	80.7	(65.8,95.5)	8.3	(0.0,22.8)
	7/05-7/09	0.0	Trace	0.0	Trace	93.5	(84.2,100)	6.5	(0.0,15.8)
	7/10-7/11	0.0	Trace	0.0	Trace	100.0	(93.3,100)	0.0	Trace
	7/12-7/14	6.3	(0.0,19.1)	0.0	Trace	91.8	(77.3,100)	1.9	(0.0,17.1)
	7/15-8/27	0.0	Trace	0.0	Trace	93.5	(84.2,100)	6.5	(0.0,15.8)
Ugashik	6/11-7/05	0.0	Trace	0.0	Trace	38.4	(25.3,51.4)	61.6	(48.6,74.7)
	7/06-7/13	0.0	Trace	0.0	Trace	14.0	(2.0,26.0)	86.0	(74.0,98.0)
	7/14	5.2	(0.0,25.5)	0.0	Trace	7.8	(0.0,18.5)	87.0	(64.2,100)
	7/15-9/01	0.0	Trace	0.0	Trace	5.9	(0.0,15.0)	94.1	(85.0,100)

^a Trace was recorded for systems that were originally included in the model used to classify the catch, the point estimates were zero, and the upper bounds of the 90% C.I. were greater than zero.

Table 10. Estimated harvest of age-2.2 sockeye salmon and 90% confidence intervals (C.I.), Eastside Bristol Bay, 1992.

District	River	Percent	Number	Standard Error	90% C.I.	
					Lower	Upper
Naknek-Kvichak	Kvichak	64.9	1,633,774	129,070	1,356,648	1,910,900
	Naknek	11.7	295,876	85,357	112,607	479,145
	Egegik	15.0	378,577	63,904	241,369	515,784
	Ugashik	8.4	211,874	99,397	0	425,288
	Total	100.0	2,520,101			
Egegik	Kvichak	2.8	202,763	56,967	80,450	325,077
	Naknek	2.3	169,486	86,933	0	356,140
	Egegik	89.2	6,449,781	215,925	5,986,170	6,913,391
	Ugashik	5.7	414,889	170,292	49,258	780,521
	Total	100.0	7,236,919			
Ugashik	Kvichak	1.4	14,149	25,736	0	69,407
	Naknek	0.0	0	0		
	Egegik	8.1	82,393	37,135	2,662	162,125
	Ugashik	90.5	924,516	53,390	809,883	1,039,148
	Total	100.0	1,021,058			
Total Eastside	Kvichak	17.2	1,850,686	143,411	1,542,769	2,158,603
	Naknek	4.3	465,362	121,833	203,776	726,948
	Egegik	64.1	6,910,751	228,224	6,420,732	7,400,768
	Ugashik	14.4	1,551,279	204,278	1,112,676	1,989,882
	Total	100.0	10,778,078			

Table 11. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.3 sockeye salmon by fishery and date for the Eastside of Bristol Bay, 1992.

District	Date	Kvichak/Naknek ^a		Egegik		Ugashik	
		Percent	90% C.I.	Percent	90% C.I.	Percent	90% C.I.
Naknek-Kvichak	6/09-6/26	82.4	(71.1,93.7)	17.6	(6.3,28.9)	0.0	Trace ^b
	6/27-6/29	69.4	(45.2,93.4)	19.2	(4.2,34.3)	11.4	(0.0,29.1)
	6/30-7/02	57.8	(19.6,95.9)	5.7	(0.0,23.9)	36.5	(4.8,68.3)
	7/03	82.1	(57.6,100)	7.7	(0.0,21.3)	10.2	(0.0,28.7)
	7/04-7/07	65.9	(42.2,89.7)	18.8	(4.2,33.4)	15.3	(0.0,33.0)
	7/08-7/11	57.6	(34.2,81.0)	32.3	(16.1,48.5)	10.1	(0.0,26.4)
	7/12	69.6	(45.2,93.9)	19.8	(4.5,35.2)	10.6	(0.0,28.3)
	7/13-7/14	79.2	(54.4,100)	4.5	(0.0,17.4)	16.3	(0.0,35.7)
	7/15-8/18	62.9	(39.2,86.6)	19.5	(4.9,34.1)	17.6	(0.0,35.6)
Egegik	6/21-6/25	4.6	(0.0,24.5)	89.4	(71.7,100)	6.0	(0.0,18.3)
	6/27-6/29	2.2	(0.0,21.9)	96.0	(78.6,100)	1.8	(0.0,12.9)
	6/30	9.1	(0.0,30.1)	89.5	(71.2,100)	1.4	(0.0,13.0)
	7/01-7/04	34.6	(9.0,60.1)	63.2	(42.5,83.8)	2.2	(0.0,17.2)
	7/05-7/09	7.2	(0.0,18.9)	92.8	(81.1,100)		Trace
	7/10-7/11	2.1	(0.0,22.1)	87.4	(69.4,100)	10.5	(0.0,23.9)
	7/12-7/14	0.0	Trace	85.2	(76.4,94.1)	14.8	(5.9,23.6)
	7/15-8/27	11.3	(0.0,32.8)	83.7	(64.9,100)	5.0	(0.0,18.0)
Ugashik	6/11-7/05	13.2	(0.0,35.2)	11.0	(0.8,21.1)	75.8	(56.1,95.5)
	7/06-7/13	7.5	(0.0,29.8)	3.8	(0.0,11.5)	88.7	(68.8,100)
	7/14	13.7	(0.0,36.5)	3.0	(0.0,10.7)	83.3	(63.1,100)
	7/15-9/01	13.7	(0.0,35.9)	9.7	(0.0,19.6)	76.6	(56.7,96.5)

^a Kvichak and Naknek Rivers combined.

^b Trace was recorded for systems that were included in the model used to classify the catch, the point estimates were zero, and the upper bounds of the 90% C.I. was greater than zero.

Table 12. Estimated harvest of age-2.3 sockeye salmon and 90% confidence intervals (C.I.), Eastside of Bristol Bay, 1992.

District	River	Percent	Number	Standard Error	90% C.I.	
					Lower	Upper
Naknek-Kvichak	Kvi/Nak ^a	65.3	1,845,647	157,437	1,507,615	2,183,678
	Egegik	20.7	585,882	97,974	375,522	796,241
	Ugashik	14.0	397,351	111,846	157,208	637,495
	Total	100.0	2,828,880			
Egegik	Kvi/Nak	11.6	450,443	146,753	135,352	765,535
	Egegik	83.9	3,251,877	155,510	2,917,983	3,585,771
	Ugashik	4.5	173,750	77,354	7,663	339,836
	Total	100.0	3,876,070			
Ugashik	Kvi/Nak	12.3	130,265	65,212	0	270,281
	Egegik	6.6	70,157	26,944	12,306	128,009
	Ugashik	81.1	859,135	63,806	722,138	996,132
	Total	100.0	1,059,557			
Total Eastside	Kvi/Nak	31.2	2,426,355	224,890	1,943,496	2,909,214
	Egegik	50.4	3,907,916	185,764	3,509,064	4,306,768
	Ugashik	18.4	1,430,236	150,214	1,107,712	1,752,760
	Total	100.0	7,764,507			

^a Kvichak and Naknek Rivers combined.

Table 13. Run composition estimates of sockeye salmon catch by age group and date, Naknek-Kvichak District, 1992.

Date	System	1.2		1.3		2.2		1.4		2.3		2.4		3.3		Other*		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/09 ^b	Kvichak	99.4	18,056	93.3	39,111	96.3	48,596	94.7	3,823	82.4	27,381	100.0	932	0.0	0	99.7	309	92.8	138,208
-	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/26	Egegik	0.5	95	6.4	2,684	3.3	1,665	4.7	189	17.6	5,848	0.0	0	0.0	0	0.3	1	7.0	10,482
	Ugashik	0.1	17	0.3	129	0.4	202	0.6	25	0.0	0	0.0	0	0.0	0	0.0	0	0.2	372
	Total	100.0	18,167	100.0	41,924	100.0	50,463	100.0	4,037	100.0	33,229	100.0	932	0.0	0	100.0	310	100.0	149,062
6/27 ^c	Kvichak	81.2	10,872	47.0	24,574	78.1	25,389	3.7	95	31.5	16,063	30.7	196	0.0	0	0.0	0	50.7	77,190
-	Naknek	12.1	1,621	33.1	17,281	11.8	3,836	94.0	2,395	37.9	19,327	69.3	441	0.0	0	0.0	0	29.5	44,901
6/28	Egegik	1.1	149	8.4	4,403	2.8	910	0.5	12	19.2	9,791	0.0	0	0.0	0	0.0	0	10.0	15,265
	Ugashik	5.6	743	11.5	6,011	7.3	2,373	1.8	46	11.4	5,813	0.0	0	0.0	0	0.0	0	9.8	14,986
	Total	100.0	13,385	100.0	52,269	100.0	32,508	100.0	2,549	100.0	50,994	100.0	637	0.0	0	0.0	0	100.0	152,342
6/29 ^c	Kvichak	91.6	21,269	68.6	24,312	97.7	48,589	8.4	476	31.5	10,788	51.0	152	0.0	0	98.4	293	71.1	105,879
-	Naknek	5.8	1,350	20.5	7,278	2.3	1,144	89.8	5,080	37.9	12,980	49.0	146	0.0	0	0.0	0	18.8	27,977
	Egegik	0.5	125	5.3	1,869	0.0	0	0.5	26	19.2	6,575	0.0	0	0.0	0	0.5	2	5.8	8,597
	Ugashik	2.1	484	5.6	1,980	0.0	0	1.3	76	11.4	3,904	0.0	0	0.0	0	1.1	3	4.3	6,447
	Total	100.0	23,228	100.0	35,438	100.0	49,733	100.0	5,658	100.0	34,247	100.0	298	0.0	0	100.0	298	100.0	148,900
6/30	Kvichak	91.5	109,306	70.0	66,886	87.5	172,438	12.2	364	29.6	21,212	0.0	0	0.0	0	0.0	0	76.1	370,206
-	Naknek	3.7	4,438	13.4	12,810	4.7	9,262	83.2	2,485	28.2	20,209	0.0	0	0.0	0	0.0	0	10.1	49,205
7/02	Egegik	0.5	582	4.9	4,664	7.8	15,372	0.6	18	5.7	4,085	0.0	0	0.0	0	0.0	0	5.1	24,721
	Ugashik	4.3	5,110	11.7	11,189	0.0	0	4.0	119	36.5	26,157	0.0	0	0.0	0	0.0	0	8.7	42,575
	Total	100.0	119,437	100.0	95,550	100.0	197,072	100.0	2,986	100.0	71,662	0.0	0	0.0	0	0.0	0	100.0	486,707
7/03 ^c	Kvichak	60.6	18,874	24.6	18,082	61.0	38,648	1.0	71	6.7	6,332	10.4	220	8.0	84	9.8	104	30.1	82,415
-	Naknek	34.4	10,708	66.0	48,390	38.5	24,393	98.4	6,751	75.4	71,261	89.6	1,892	90.6	957	23.2	245	60.2	164,597
	Egegik	0.5	169	2.9	2,119	0.5	317	0.1	6	7.7	7,277	0.0	0	1.4	15	46.1	487	3.8	10,389
	Ugashik	4.5	1,400	6.5	4,799	0.0	0	0.5	37	10.2	9,640	0.0	0	0.0	0	20.9	220	5.9	16,097
	Total	100.0	31,151	100.0	73,390	100.0	63,358	100.0	6,864	100.0	94,511	100.0	2,112	100.0	1,056	100.0	1,056	100.0	273,498

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Table 13. (p 2 of 3).

Date	System	1.2		1.3		2.2		1.4		2.3		2.4		3.3		Other*		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/04	Kvichak	81.7	375,667	47.5	408,655	72.3	753,857	4.4	3,152	25.4	255,257	34.5	4,733	26.0	891	94.8	3,250	52.2	1,805,463
-	Naknek	10.3	47,156	28.1	241,966	6.5	67,774	92.4	66,582	40.5	407,005	65.5	8,987	65.4	2,242	0.0	0	24.3	841,712
7/07	Egegik	1.4	6,488	10.7	92,369	13.4	139,719	0.7	513	18.8	188,931	0.0	0	8.6	297	1.5	54	12.4	428,371
	Ugashik	6.6	30,290	13.7	117,906	7.8	81,329	2.5	1,780	15.3	153,757	0.0	0	0.0	0	3.7	125	11.1	385,188
	Total	100.0	459,602	100.0	860,896	100.0	1,042,679	100.0	72,027	100.0	1,004,950	100.0	13,720	100.0	3,430	100.0	3,430	100.0	3,460,734
7/08 ^c	Kvichak	71.4	73,437	30.0	111,332	51.7	162,093	2.1	604	14.1	63,105	19.7	1,412	13.1	315	0.0	0	32.4	412,299
-	Naknek	19.3	19,830	38.2	141,803	10.6	33,234	95.7	27,469	43.5	194,686	80.3	5,768	71.2	1,703	0.0	0	33.4	424,492
7/09	Egegik	4.3	4,544	24.3	90,155	37.7	118,199	1.2	353	32.3	144,560	0.0	0	15.7	375	0.0	0	28.1	358,186
	Ugashik	5.0	5,102	7.5	27,677	0.0	0	1.0	294	10.1	45,203	0.0	0	0.0	0	0.0	0	6.1	78,276
	Total	100.0	102,913	100.0	370,967	100.0	313,526	100.0	28,720	100.0	447,554	100.0	7,180	100.0	2,393	0.0	0	100.0	1,273,253
7/10 ^c	Kvichak	74.5	95,887	36.4	110,788	65.3	201,863	2.8	906	14.1	51,458	25.0	1,607	0.0	0	10.0	647	40.2	463,157
-	Naknek	14.8	19,061	34.1	103,879	9.7	29,986	94.2	30,309	43.5	158,753	75.0	4,833	0.0	0	13.4	861	30.2	347,682
7/11	Egegik	2.3	2,993	14.8	45,257	10.1	31,222	0.8	267	32.3	117,879	0.0	0	0.0	0	64.6	4,156	17.5	201,773
	Ugashik	8.4	10,863	14.7	44,914	14.9	46,061	2.2	719	10.1	36,860	0.0	0	0.0	0	12.0	776	12.1	140,192
	Total	100.0	128,804	100.0	304,838	100.0	309,132	100.0	32,201	100.0	364,949	100.0	6,440	0.0	0	100.0	6,440	100.0	1,152,804
7/12	Kvichak	72.1	29,607	34.0	31,273	65.8	58,159	2.1	143	14.4	17,138	19.2	402	14.2	99	56.1	780	39.2	137,602
	Naknek	20.0	8,218	44.6	40,944	14.3	12,639	96.2	6,698	55.2	65,695	80.8	1,686	79.0	550	14.9	207	38.9	136,638
	Egegik	1.8	738	11.1	10,207	13.4	11,844	0.5	34	19.8	23,564	0.0	0	6.8	47	20.6	287	13.3	46,722
	Ugashik	6.1	2,499	10.3	9,444	6.5	5,745	1.2	85	10.6	12,615	0.0	0	0.0	0	8.4	117	8.6	30,505
	Total	100.0	41,062	100.0	91,869	100.0	88,388	100.0	6,960	100.0	119,012	100.0	2,088	100.0	696	100.0	1,392	100.0	351,467
7/13 ^c	Kvichak	49.4	38,259	17.6	41,622	42.6	83,235	0.8	137	4.8	13,166	7.9	239	6.0	90	88.5	664	22.0	177,412
-	Naknek	37.9	29,325	63.6	150,486	37.3	72,879	97.8	17,648	74.4	204,075	92.1	2,766	92.1	1,385	0.0	0	59.3	478,565
7/14	Egegik	0.8	618	3.7	8,792	8.7	16,999	0.1	21	4.5	12,343	0.0	0	1.9	28	1.3	10	4.8	38,811
	Ugashik	11.9	9,201	15.1	35,818	11.4	22,274	1.3	230	16.3	44,710	0.0	0	0.0	0	10.2	76	13.9	112,310
	Total	100.0	77,403	100.0	236,719	100.0	195,387	100.0	18,036	100.0	274,294	100.0	3,005	100.0	1,503	100.0	751	100.0	807,098

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Table 13. (p 3 of 3).

Date	System	1.2		1.3		2.2		1.4		2.3		2.4		3.3		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/15 ^d	Kvichak	32.5	26,741	9.2	37,068	23.0	40,907	0.5	355	3.4	11,338	0.0	0	0.0	0	3.6	81	10.8	116,490
-	Naknek	39.8	32,658	53.1	213,535	22.9	40,729	96.5	73,012	59.5	198,419	0.0	0	0.0	0	29.7	660	52.1	559,014
8/18	Egegik	3.5	2,914	13.1	52,865	23.8	42,329	0.5	365	19.5	65,028	0.0	0	0.0	0	40.9	908	15.3	164,410
	Ugashik	24.2	19,944	24.6	98,928	30.3	53,890	2.5	1,856	17.6	58,692	0.0	0	0.0	0	25.8	574	21.8	233,884
	Total	100.0	82,258	100.0	402,396	100.0	177,855	100.0	75,588	100.0	333,478	0.0	0	0.0	0	100.0	2,223	100.0	1,073,798
Total	Kvichak	74.5	817,977	35.6	913,704	64.9	1,633,774	4.0	10,126	17.4	493,238	27.2	9,893	16.3	1,479	38.6	6,130	41.7	3,886,321
	Naknek	15.9	174,366	38.1	978,373	11.7	295,876	93.3	238,430	47.9	1,352,409	72.8	26,519	75.3	6,837	12.4	1,973	33.0	3,074,783
	Egegik	1.8	19,413	12.3	315,384	15.0	378,577	0.6	1,804	20.7	585,882	0.0	0	8.4	762	37.1	5,905	14.0	1,307,727
	Ugashik	7.8	85,654	14.0	358,795	8.4	211,874	2.1	5,266	14.0	397,351	0.0	0	0.0	0	11.9	1,892	11.3	1,060,832
	Total	100.0	1,097,410	100.0	2,566,256	100.0	2,520,101	100.0	255,626	100.0	2,828,880	100.0	36,412	100.0	9,078	100.0	15,900	100.0	9,329,663

^a Other includes ages 0.2, 1.1, 0.3, 2.1, 0.4, and 3.2.

^b Scale samples were collected on 18, 19, and 23 June. Stock composition estimates calculated for these dates were applied to 9 through 26 June catches.

^c Naknek Section only openings.

^d Scale samples were collected on 15 and 19 July. Stock composition estimates calculated for these dates were applied to 15 July through 18 August catches.

Table 14. Run composition estimates of sockeye salmon setnet catch, Naknek-Kvichak District, 1992.

Area	Percent Classification by Stock				Total
	Kvichak	Naknek	Egegik	Ugashik	
Kvichak Section ^a	78.9	17.4	3.7	0.0	100.0
Naknek Section ^b	23.4	76.6	0.0	0.0	100.0

^a Samples collected on 6/22 and 7/05. Specific sample areas within Kvichak Section are unknown.

^b Samples collected 7/05 on North Naknek Section beaches from Libbyville to Inside Marker.

Table 15. Run composition estimates of sockeye salmon catch by age group and date, Egegik District, 1992.

Date	River	1.2		1.3		2.2		1.4		2.3		3.2		Other*		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/21 ^b	Kvichak	63.4	15,861	15.2	54,233	16.7	71,944	16.9	443	4.6	14,064	0.0	0	0.0	0	14.0	156,545
-	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/25	Egegik	23.5	5,862	73.6	262,335	75.7	326,117	58.8	1,545	89.4	273,339	99.4	653	0.0	0	77.5	869,852
	Ugashik	13.1	3,261	11.2	39,895	7.6	32,741	24.3	638	6.0	18,345	0.6	4	0.0	0	8.5	94,883
	Total	100.0	24,983	100.0	356,463	100.0	430,802	100.0	2,627	100.0	305,748	100.0	657	0.0	0	100.0	1,121,280
6/27	Kvichak	66.5	46,629	18.9	55,843	23.3	92,320	13.1	442	0.5	1,112	0.0	0	90.1	1,294	19.9	197,638
-	Naknek	1.0	714	1.4	4,036	0.4	1,585	33.8	1,139	1.7	3,780	0.0	0	0.0	0	1.1	11,254
6/29	Egegik	17.3	12,119	64.2	189,960	61.7	244,471	32.1	1,082	96.0	213,474	99.1	1,918	0.0	0	67.0	663,024
	Ugashik	15.2	10,684	15.5	45,784	14.6	57,849	21.0	709	1.8	4,003	0.9	17	9.9	142	12.0	119,188
	Total	100.0	70,146	100.0	295,622	100.0	396,225	100.0	3,371	100.0	222,369	100.0	1,935	100.0	1,436	100.0	991,104
6/30	Kvichak	2.7	327	0.3	435	0.0	0	0.1	1	0.5	821	0.0	0	0.2	2	0.2	1,586
	Naknek	12.3	1,499	5.4	9,411	0.0	0	72.7	986	8.6	14,127	0.0	0	14.7	199	4.1	26,223
	Egegik	73.9	9,041	90.6	157,487	97.4	281,645	24.5	333	89.5	147,019	99.8	1,356	85.1	1,157	93.0	598,038
	Ugashik	11.1	1,352	3.7	6,437	2.6	7,518	2.7	37	1.4	2,300	0.2	2	0.0	0	2.7	17,645
	Total	100.0	12,218	100.0	173,770	100.0	289,163	100.0	1,358	100.0	164,267	100.0	1,358	100.0	1,358	100.0	643,492
7/01	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
-	Naknek	45.8	42,663	29.0	374,094	11.0	167,901	94.3	20,275	34.6	285,137	0.0	0	0.0	0	23.7	890,070
7/04	Egegik	35.2	32,804	61.9	798,111	80.7	1,231,782	4.1	873	63.2	520,829	0.0	0	0.0	0	68.8	2,584,399
	Ugashik	19.0	17,692	9.1	117,684	8.3	126,689	1.6	350	2.2	18,130	0.0	0	0.0	0	7.5	280,545
	Total	100.0	93,158	100.0	1,289,890	100.0	1,526,372	100.0	21,498	100.0	824,096	0.0	0	0.0	0	100.0	3,755,014
7/05	Kvichak	1.9	1,574	0.2	2,119	0.0	0	0.1	14	0.4	4,217	0.0	0	0.1	11	0.2	7,935
-	Naknek	8.8	7,139	4.1	45,333	0.0	0	65.1	10,534	6.8	71,681	0.0	0	8.1	982	3.2	135,670
7/09	Egegik	68.9	55,615	88.5	979,955	93.5	1,831,525	28.5	4,598	92.8	978,246	99.7	24,161	90.9	11,018	91.3	3,885,115
	Ugashik	20.4	16,449	7.2	79,244	6.5	127,325	6.3	1,010	0.0	0	0.3	73	0.9	106	5.3	224,208
	Total	100.0	80,777	100.0	1,106,650	100.0	1,958,850	100.0	16,156	100.0	1,054,144	100.0	24,234	100.0	12,117	100.0	4,252,928

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Table 15. (p 2 of 2).

Date	River	1.2		1.3		2.2		1.4		2.3		3.2		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/10	Kvichak	0.5	42	0.0	157	0.0	0	0.0	8	0.1	569	0.0	0	0.0	0	0.0	776
-	Naknek	2.6	227	1.1	3,943	0.0	0	33.5	7,279	2.0	11,375	0.0	0	0.0	0	1.0	22,824
7/11	Egegik	79.1	6,871	93.2	331,550	100.0	1,237,389	57.0	12,359	87.4	497,100	99.8	12,995	0.0	0	95.2	2,098,264
	Ugashik	17.8	1,544	5.7	20,371	0.0	0	9.5	2,063	10.5	59,720	0.2	30	0.0	0	3.8	83,728
	Total	100.0	8,684	100.0	356,021	100.0	1,237,389	100.0	21,709	100.0	568,764	100.0	13,025	0.0	0	100.0	2,205,592
7/12 ^c	Kvichak	36.3	7,644	5.4	12,683	6.3	38,499	6.2	651	0.0	0	0.0	0	2.1	289	4.7	59,767
-	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/14	Egegik	43.0	9,057	83.6	196,678	91.8	560,986	69.0	7,277	85.2	299,225	99.5	15,726	95.3	13,387	87.6	1,102,337
	Ugashik	20.7	4,370	11.0	25,945	1.9	11,611	24.8	2,608	14.8	51,978	0.5	78	2.6	372	7.7	96,961
	Total	100.0	21,072	100.0	235,306	100.0	611,096	100.0	10,536	100.0	351,203	100.0	15,804	100.0	14,048	100.0	1,259,065
7/15 ^d	Kvichak	2.5	1,029	0.3	543	0.0	0	0.1	9	0.6	2,313	0.0	0	0.2	6	0.3	3,900
-	Naknek	11.7	4,898	5.9	12,181	0.0	0	72.5	6,987	10.7	41,246	0.0	0	16.9	543	4.5	65,855
8/27	Egegik	59.8	24,984	83.8	172,396	93.5	735,866	20.7	1,997	83.7	322,646	99.6	15,990	82.9	2,663	88.1	1,276,541
	Ugashik	26.0	10,850	10.0	20,469	6.5	51,156	6.7	644	5.0	19,274	0.4	71	0.0	0	7.1	102,465
	Total	100.0	41,761	100.0	205,589	100.0	787,022	100.0	9,637	100.0	385,479	100.0	16,061	100.0	3,212	100.0	1,448,761
Total	Kvichak	20.7	73,106	3.1	126,012	2.8	202,763	1.8	1,568	0.6	23,096	0.0	0	5.0	1,602	2.7	428,147
	Naknek	16.2	57,140	11.2	448,998	2.3	169,486	54.3	47,200	11.0	427,347	0.0	0	5.4	1,725	7.3	1,151,896
	Egegik	44.3	156,353	76.8	3,088,472	89.2	6,449,781	34.6	30,064	83.9	3,251,877	99.6	72,799	87.7	28,224	83.5	13,077,570
	Ugashik	18.8	66,200	8.9	355,829	5.7	414,889	9.3	8,060	4.5	173,750	0.4	275	1.9	620	6.5	1,019,623
	Total	100.0	352,799	100.0	4,019,311	100.0	7,236,919	100.0	86,892	100.0	3,876,070	100.0	73,074	100.0	32,171	100.0	15,677,236

^a Other includes ages 0.2, 2.1, and 3.3

^b Scale samples were collected on 23 and 25 June. Stock composition estimates calculated for these dates were applied to 21 through 25 June catches.

^c Westward boundary was moved from Loran C 9990-Y-45135 to Loran C 9990-Y-45110. Scale samples were collected from catches within the reduced district.

^d Westward boundary was moved back to Loran C 9990-Y-45135. Scale samples were collected on 15 July. Stock composition estimates calculated for that date were applied to 15 July through 27 August catches.

Table 16. Run composition estimates of sockeye salmon catch by age group and date, Ugashik District, 1992.

Date	System	1.2		1.3		2.2		1.4		2.3		3.2		2.4		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/11 ^a	Kvichak	1.5	73	0.4	143	0.0	0	0.1	1	0.7	216	0.0	0	0.0	0	0.5	432
-	Naknek	7.3	346	8.6	3,218	0.0	0	65.3	564	12.5	3,855	0.0	0	0.0	0	8.5	7,984
7/05	Egegik	4.1	195	13.4	5,031	38.4	7,536	2.1	18	11.0	3,392	0.0	0	0.0	0	17.3	16,172
	Ugashik	87.1	4,131	77.6	29,136	61.6	12,090	32.5	280	75.8	23,377	0.0	0	0.0	0	73.7	69,014
	Total	100.0	4,745	100.0	37,528	100.0	19,626	100.0	863	100.0	30,840	0.0	0	0.0	0	100.0	93,602
7/06	Kvichak	0.8	267	0.2	405	0.0	0	0.1	9	0.4	951	0.0	0	0.0	0	0.2	1,632
-	Naknek	3.8	1,265	4.8	9,056	0.0	0	48.7	7,154	7.1	16,880	0.0	0	0.0	0	5.7	34,356
7/13	Egegik	1.2	408	4.3	8,095	14.0	18,326	0.9	129	3.8	9,035	55.9	747	0.0	0	6.1	36,738
	Ugashik	94.2	31,451	90.7	170,774	86.0	112,571	50.3	7,401	88.7	210,883	44.1	589	0.0	0	88.0	533,670
	Total	100.0	33,391	100.0	188,330	100.0	130,897	100.0	14,693	100.0	237,749	100.0	1,336	0.0	0	100.0	606,396
7/14	Kvichak	24.3	8,911	8.0	18,004	5.2	14,149	4.4	442	13.7	38,837	0.0	0	100.0	1,266	9.9	81,609
	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Egegik	0.7	265	3.1	7,010	7.8	21,223	1.2	124	3.0	8,504	0.0	0	0.0	0	4.4	37,127
	Ugashik	75.0	27,525	88.9	198,989	87.0	236,722	94.4	9,559	83.3	236,141	0.0	0	0.0	0	85.7	708,935
	Total	100.0	36,701	100.0	224,003	100.0	272,094	100.0	10,125	100.0	283,482	0.0	0	100.0	1,266	100.0	827,671
7/15 ^b	Kvichak	1.0	882	0.3	1,588	0.0	0	0.1	24	0.7	3,552	0.0	0	1.3	52	0.3	6,098
-	Naknek	5.0	4,368	6.3	37,110	0.0	0	55.7	19,644	13.0	65,974	0.0	0	98.7	3,931	7.2	131,026
9/01	Egegik	1.3	1,113	4.4	26,224	5.9	35,308	0.8	280	9.7	49,226	57.1	1,309	0.0	0	6.2	113,459
	Ugashik	92.7	81,762	89.0	526,927	94.1	563,133	43.4	15,302	76.6	388,734	42.9	983	0.0	0	86.3	1,576,843
	Total	100.0	88,125	100.0	591,849	100.0	598,441	100.0	35,250	100.0	507,486	100.0	2,292	100.0	3,983	100.0	1,827,426
Total	Kvichak	6.2	10,133	1.9	20,140	1.4	14,149	0.8	475	4.1	43,556	0.0	0	25.1	1,318	2.6	89,771
	Naknek	3.7	5,980	4.7	49,384	0.0	0	44.9	27,362	8.2	86,709	0.0	0	74.9	3,931	5.2	173,366
	Egegik	1.2	1,980	4.5	46,360	8.1	82,393	0.9	551	6.6	70,157	56.7	2,055	0.0	0	6.1	203,496
	Ugashik	88.9	144,869	88.9	925,826	90.5	924,516	53.4	32,543	81.1	859,135	43.3	1,573	0.0	0	86.1	2,888,462
	Total	100.0	162,962	100.0	1,041,710	100.0	1,021,058	100.0	60,931	100.0	1,059,557	100.0	3,628	100.0	5,249	100.0	3,355,095

^a Scale samples were collected on 29 June. Stock composition estimates calculated for that date were applied to 11 June through 5 July catches.

^b Scale samples were collected on 15, 17, and 18 July. Stock composition estimates calculated for those dates were applied to 15 July through 1 September catches.

Table 17. Catch of sockeye salmon by run and district for the East Side of Bristol Bay, 1992.

Run		District			Total
		Naknek-Kvichak	Egegik	Ugashik	
Kvichak	Numbers	3,886,321	428,147	89,771	4,404,239
	Percent	88.3	9.7	2.0	100.0
Naknek	Numbers	3,074,783	1,151,896	173,366	4,400,045
	Percent	69.9	26.2	3.9	100.0
Egegik	Numbers	1,307,727	13,077,570	203,496	14,588,793
	Percent	9.0	89.6	1.4	100.0
Ugashik	Numbers	1,060,832	1,019,623	2,888,462	4,968,917
	Percent	21.4	20.5	58.1	100.0
Total	Numbers	9,329,663	15,677,236	3,355,095	28,361,994
	Percent	32.9	55.3	11.8	100.0

Table 18. Numbers of sockeye salmon by run and age group for the Eastside of Bristol Bay, 1992.

		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	Total
Kvichak	Escapement	27,689	1,633	12,694	1,498,169	14,504	3,731	744,718	2,088,448		6,378	324,088		2,712	1,100	4,725,864
	In District Catch	669	104	4,362	817,977	840	155	913,704	1,633,774		10,126	493,238		9,893	1,479	3,886,421
	Other Dist. Catch	1,294			83,239	69		146,152	216,912		2,043	66,652		1,318	239	517,918
	Total Run	29,652	1,737	17,056	2,399,385	15,413	3,886	1,804,574	3,939,134		18,547	883,978		13,923	2,818	9,130,103
Naknek	Escapement		710		157,348	10,186	522	368,951	253,544		112,584	696,183		4,289	2,333	1,606,650
	In District Catch		245		174,366	1,728		978,373	295,876		238,430	1,352,409		26,519	6,837	3,074,783
	Other Dist. Catch				63,120	32		498,382	169,486		74,562	514,056		3,931	1,693	1,325,262
	Total Run		955		394,834	11,946	522	1,845,706	718,906		425,576	2,562,648		34,739	10,863	6,006,695
Egegik	Escapement			405	49,546	49,511		322,333	1,169,346	3,093	1,983	335,192	13,519		704	1,945,632
	In District Catch				156,353	12,240		3,088,472	6,449,781		30,064	3,251,877	72,799		15,984	13,077,570
	Other Dist. Catch			67	21,393	3,281		361,744	460,970		2,355	656,039	4,612		762	1,511,223
	Total Run			472	227,292	65,032		3,772,549	8,080,097	3,093	34,402	4,243,108	90,930		17,450	16,534,425
Ugashik	Escapement	2,575	7,333	1,164	289,013	26,666		514,078	764,065		8,605	580,615	813			2,194,927
	In District Catch				144,869			925,826	924,516		32,543	859,135	1,573			2,888,462
	Other Dist. Catch	169	179	205	151,854	1,841		714,624	626,763		13,326	571,101	393			2,080,455
	Total Run	2,744	7,512	1,369	585,736	28,507		2,154,528	2,315,344		54,474	2,010,851	2,779			7,163,844

Table 19. Percentages of sockeye salmon by run and age group for the Eastside of Bristol Bay, 1992.

		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	Total
Kvichak	Escapement	0.3	0.0 ^a	0.1	16.4	0.2	0.0	8.2	22.9		0.1	3.5		0.0	0.0	51.7
	In District Catch	0.0	0.0	0.0	9.0	0.0	0.0	10.0	17.9		0.1	5.4		0.1	0.0	42.6
	Other Dist. Catch	0.0			0.9	0.0		1.6	2.4		0.0	0.7		0.0	0.0	5.7
	Total Run	0.3	0.0	0.2	26.3	0.2	0.0	19.8	43.1		0.2	9.7		0.2	0.0	100.0
Naknek	Escapement		0.0		2.6	0.2	0.0	6.1	4.2		1.9	11.6		0.1	0.0	26.7
	In District Catch		0.0		2.9	0.0		16.3	4.9		4.0	22.5		0.4	0.1	51.2
	Other Dist. Catch				1.1	0.0		8.3	2.8		1.2	8.6		0.1	0.0	22.1
	Total Run		0.0		6.6	0.2		30.7	12.0		7.1	42.7		0.6	0.2	100.0
Egegik	Escapement			0.0	0.3	0.3		1.9	7.1	0.0	0.0	2.0	0.1		0.0	11.8
	In District Catch				0.9	0.1		18.7	39.0		0.2	19.7	0.4		0.1	79.1
	Other Dist. Catch			0.0	0.1	0.0		2.2	2.8		0.0	4.0	0.0		0.0	9.1
	Total Run			0.0	1.4	0.4		22.8	48.9	0.0	0.2	25.7	0.5		0.1	100.0
Ugashik	Escapement	0.0	0.0	0.0	4.0	0.4		7.2	10.7		0.1	8.1	0.0			30.7
	In District Catch				2.0			12.9	12.9		0.5	12.0	0.0			40.3
	Other Dist. Catch	0.0	0.0	0.0	2.1	0.0		10.0	8.7		0.2	8.0	0.0			29.0
	Total Run	0.0	0.0	0.0	8.2	0.4		30.1	32.3		0.8	28.1	0.0			100.0

^a Represented <0.1%

Table 20. Comparison of sockeye salmon run estimates for the Eastside of Bristol Bay, 1992.

Stock	Estimated Run		Difference	
	Standard Method ^a	Scale Pattern Analysis	Number	Percent
Kvichak	10,609,772	9,130,103	1,479,669	13.9
Naknek	5,052,405	6,006,695	- 954,290	-18.9
Egegik	17,622,868	16,534,425	1,088,443	6.2
Ugashik	5,550,022	7,163,844	-1,613,822	-29.1
Total	38,835,067	38,835,067		

^a Standard method assumes fish harvested in a district originated within that district and divides Naknek-Kvichak District catch to Naknek and Kvichak Rivers based on escapement age composition. These numbers have been adjusted to include Branch River run.

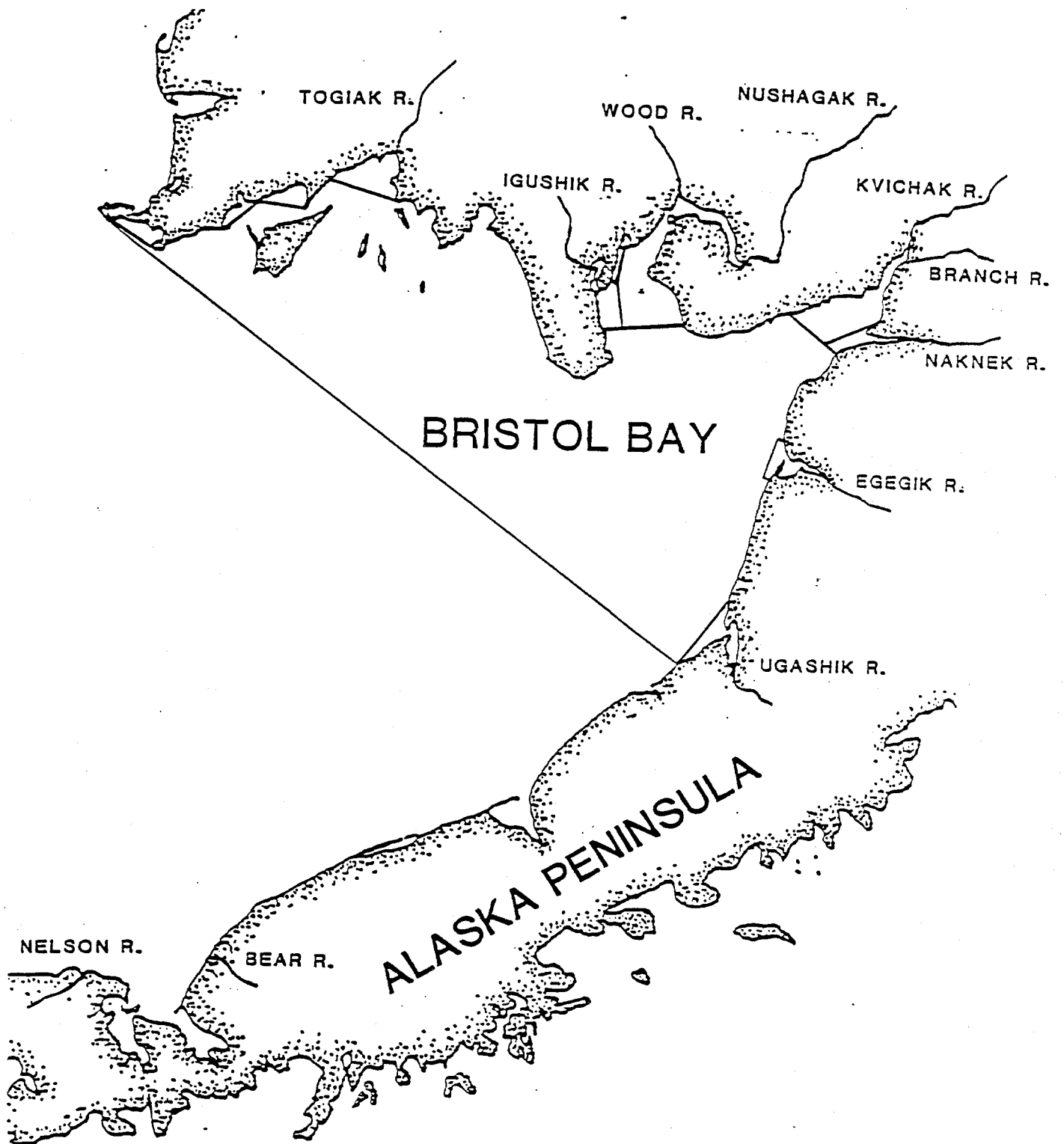


Figure 1. Map of Bristol Bay showing major rivers and fishing districts.

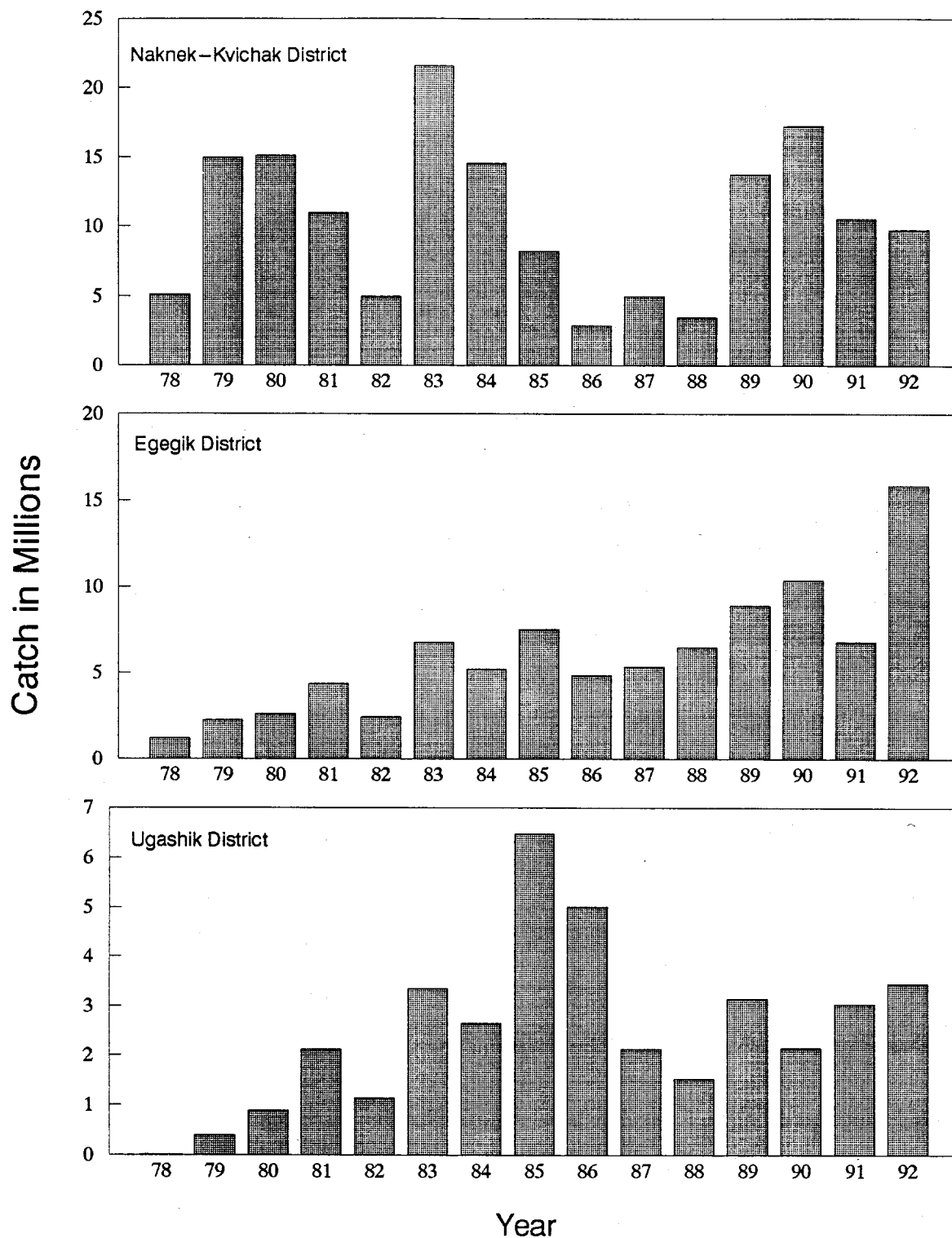


Figure 2. Commercial catch of sockeye salmon in Naknek-Kvichak, Egegik, and Ugashik Districts from 1978 through 1992.

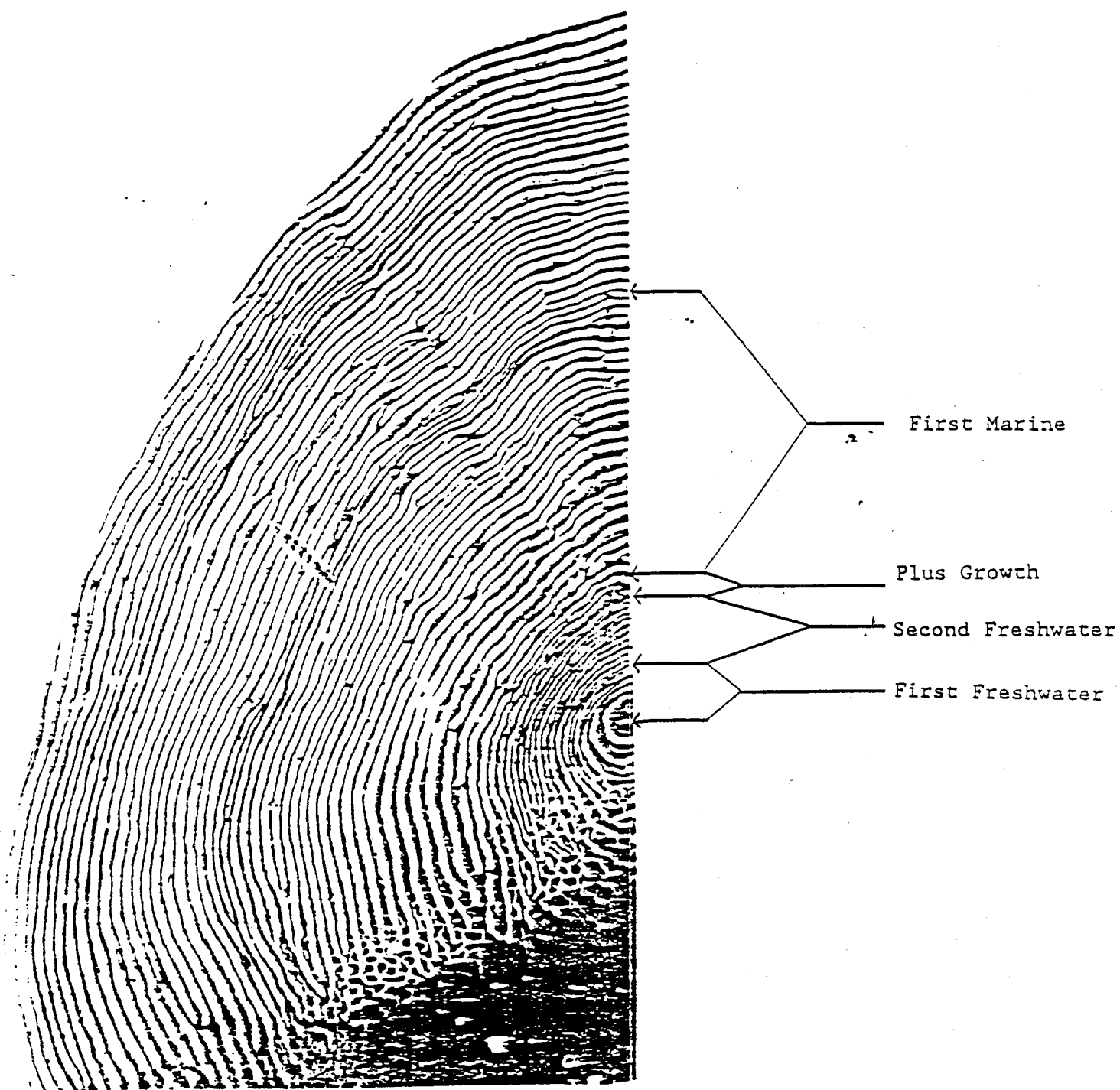


Figure 3. Age-2.2 sockeye salmon scale showing the growth zones measured to generate variables to build linear discriminant functions.

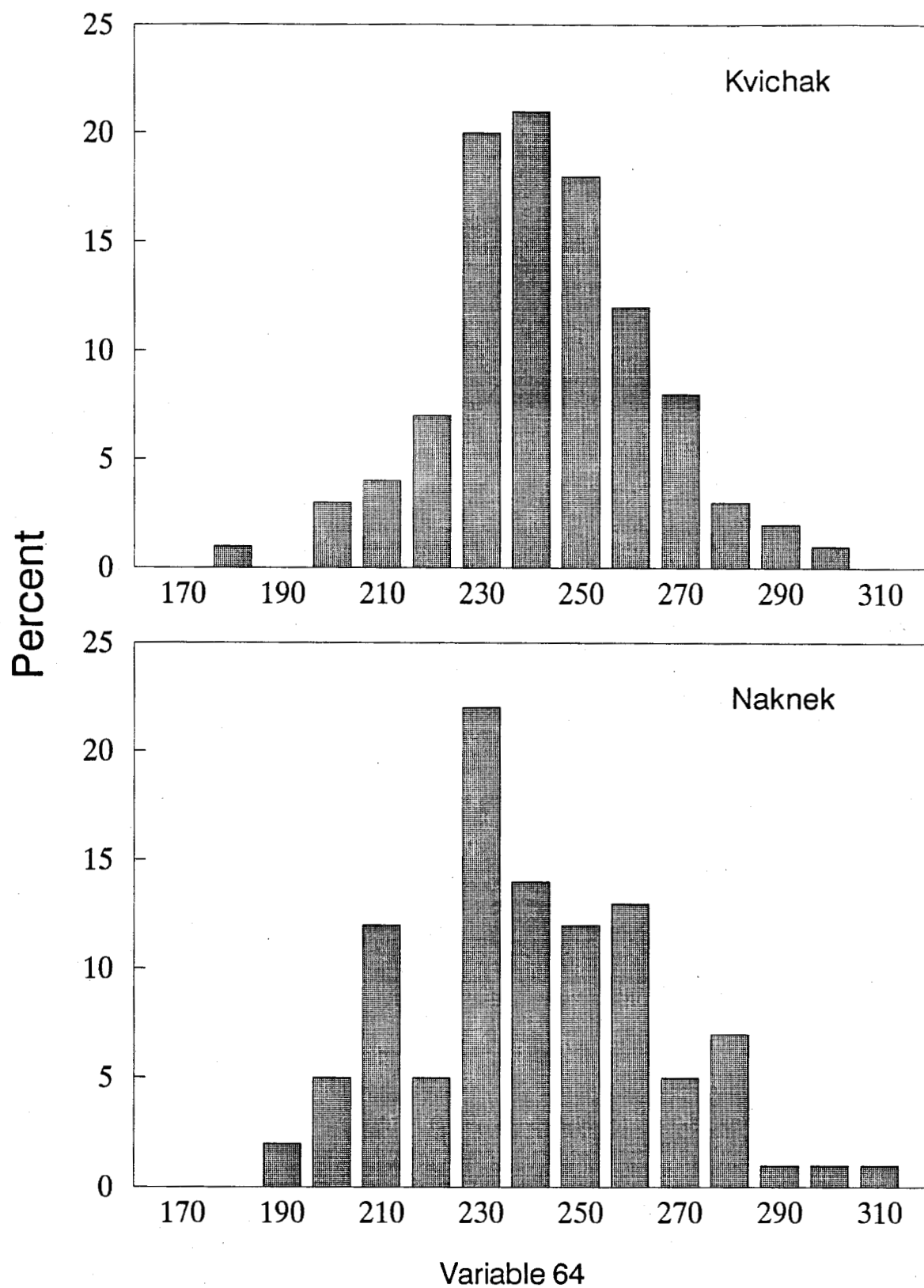


Figure 4. Total size of first and second freshwater growth zones (S1FW+S2FW) for age-2.3 sockeye salmon escapement scales, Kvichak and Naknek Rivers, 1992.

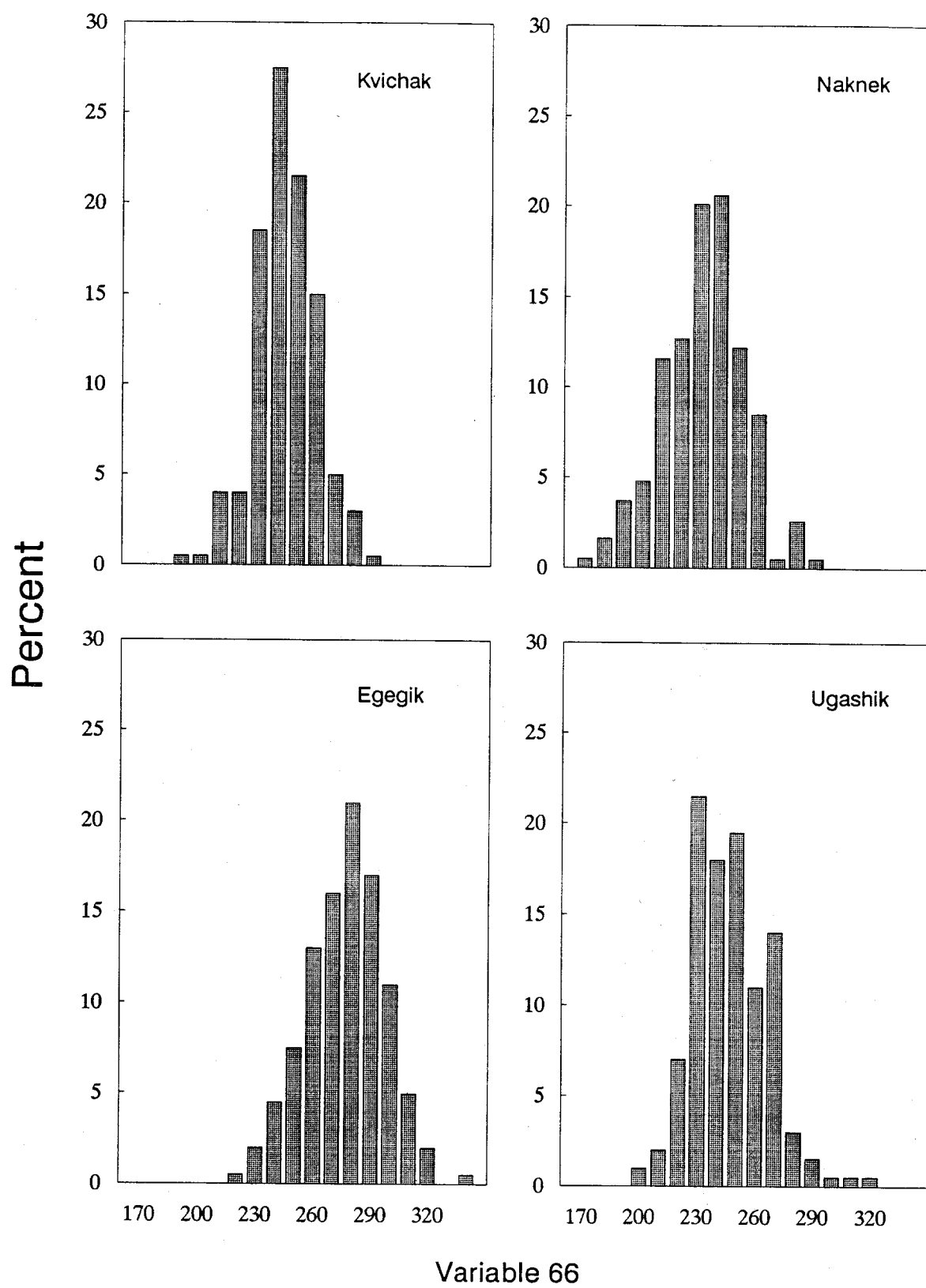


Figure 5. Total size of all freshwater growth zones (S1FW + S2FW + SPGZ), age-2.2 sockeye salmon escapement scales, Kvichak, Naknek, Egegik, Ugashik Rivers, 1992.

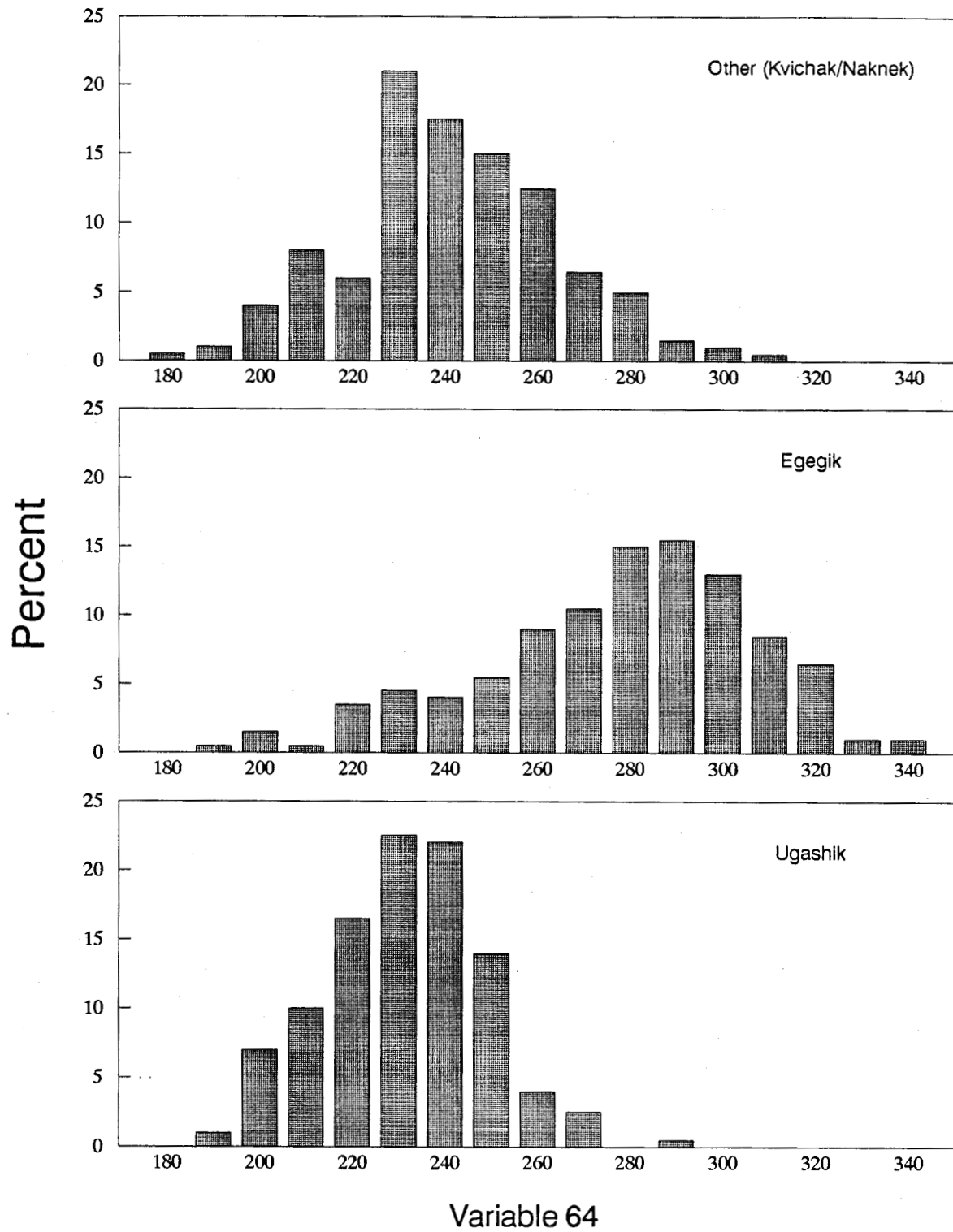


Figure 6. Total size of first and second freshwater growth zones (S1FW+S2FW) for age-2.3 sockeye salmon escapement scales, Egegik, Ugashik, and Kvichak/Naknek (Other) Rivers combined, 1992.

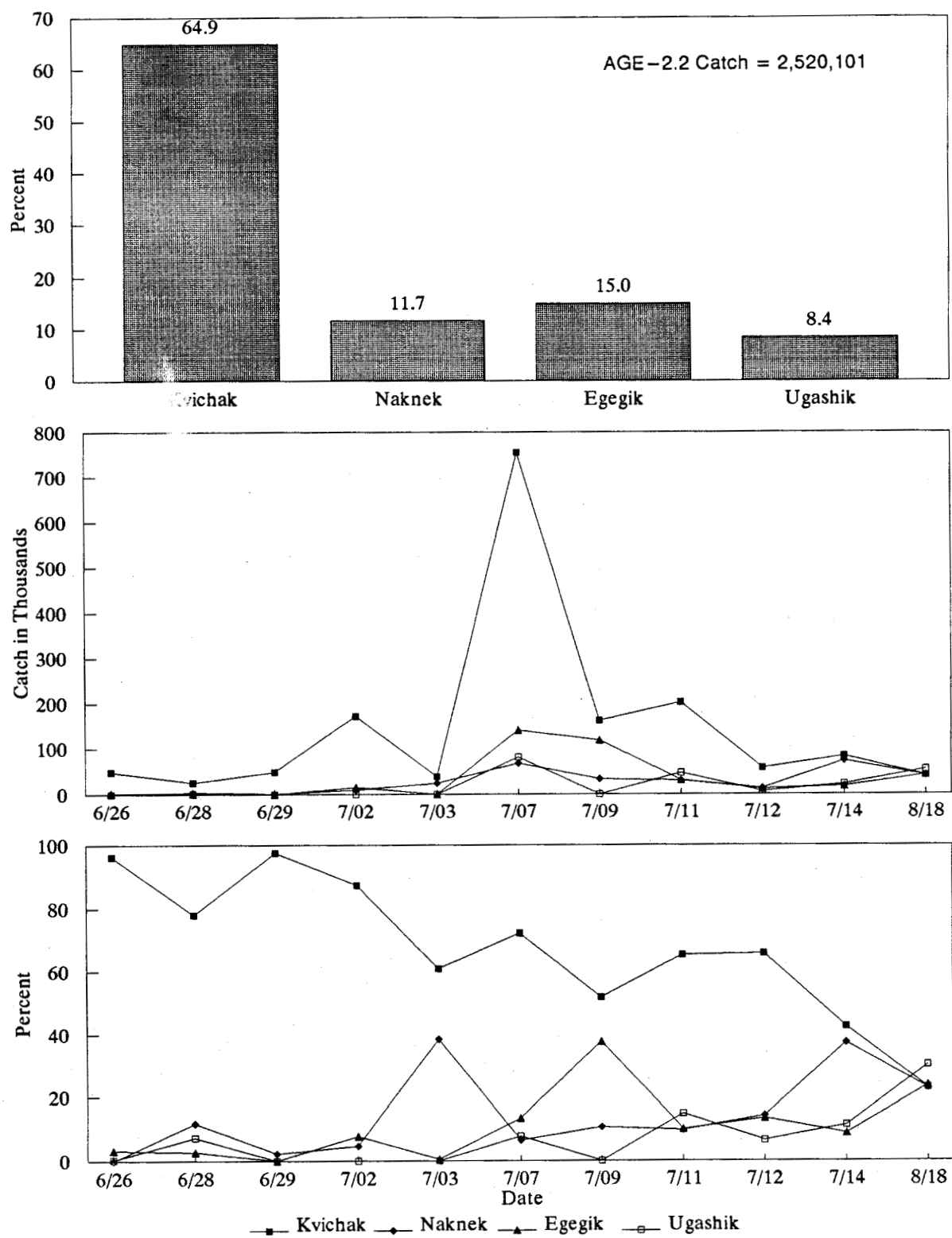


Figure 7. Stock composition estimates for 1992 Naknek-Kvichak District age-2.2 sockeye salmon catch in percent and numbers through time.

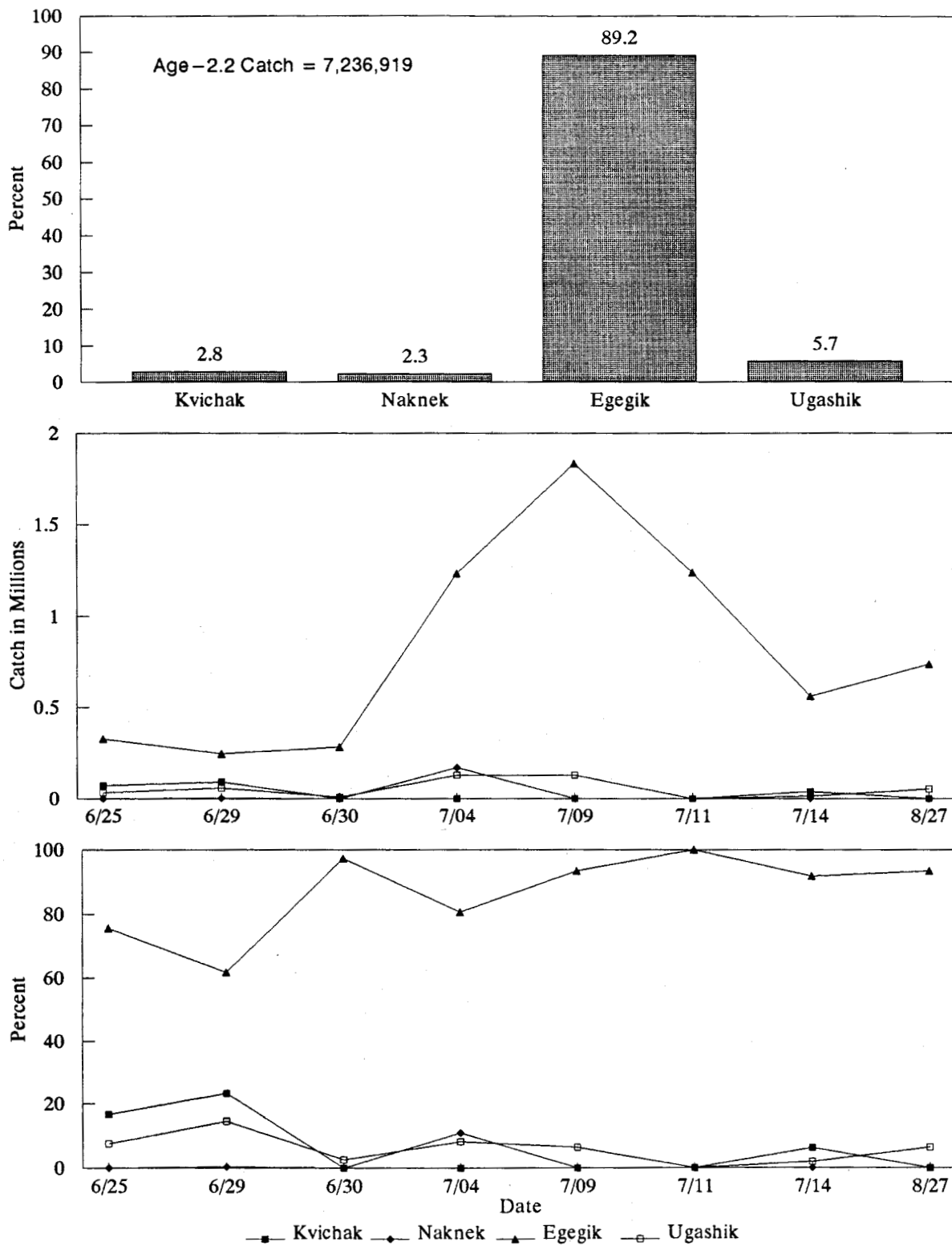


Figure 8. Stock composition estimates for 1992 Egegik District age-2.2 sockeye salmon catch in percent and numbers through time.

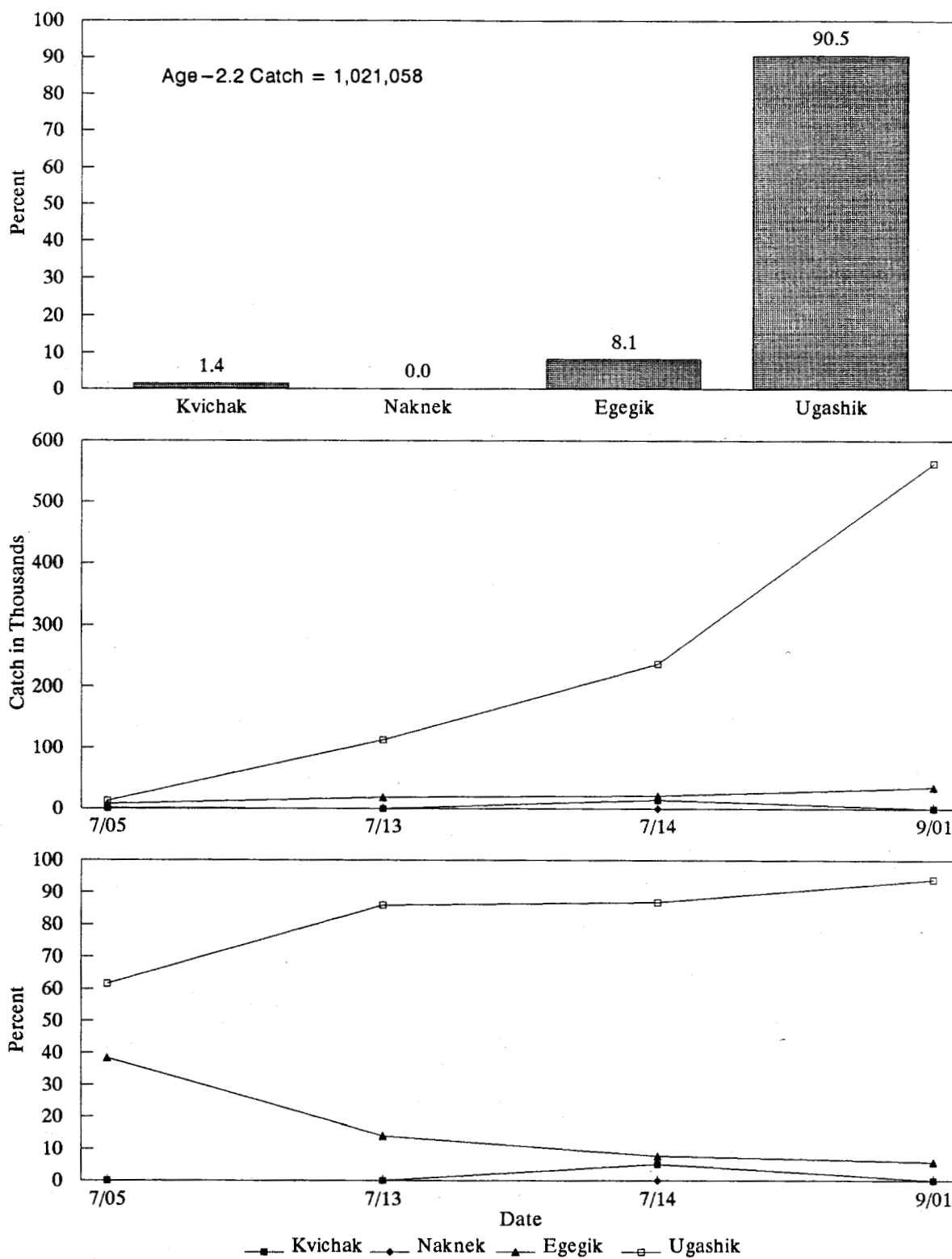


Figure 9. Stock composition estimates for 1992 Ugashik District age-2.2 sockeye salmon catch in percent and numbers through time.

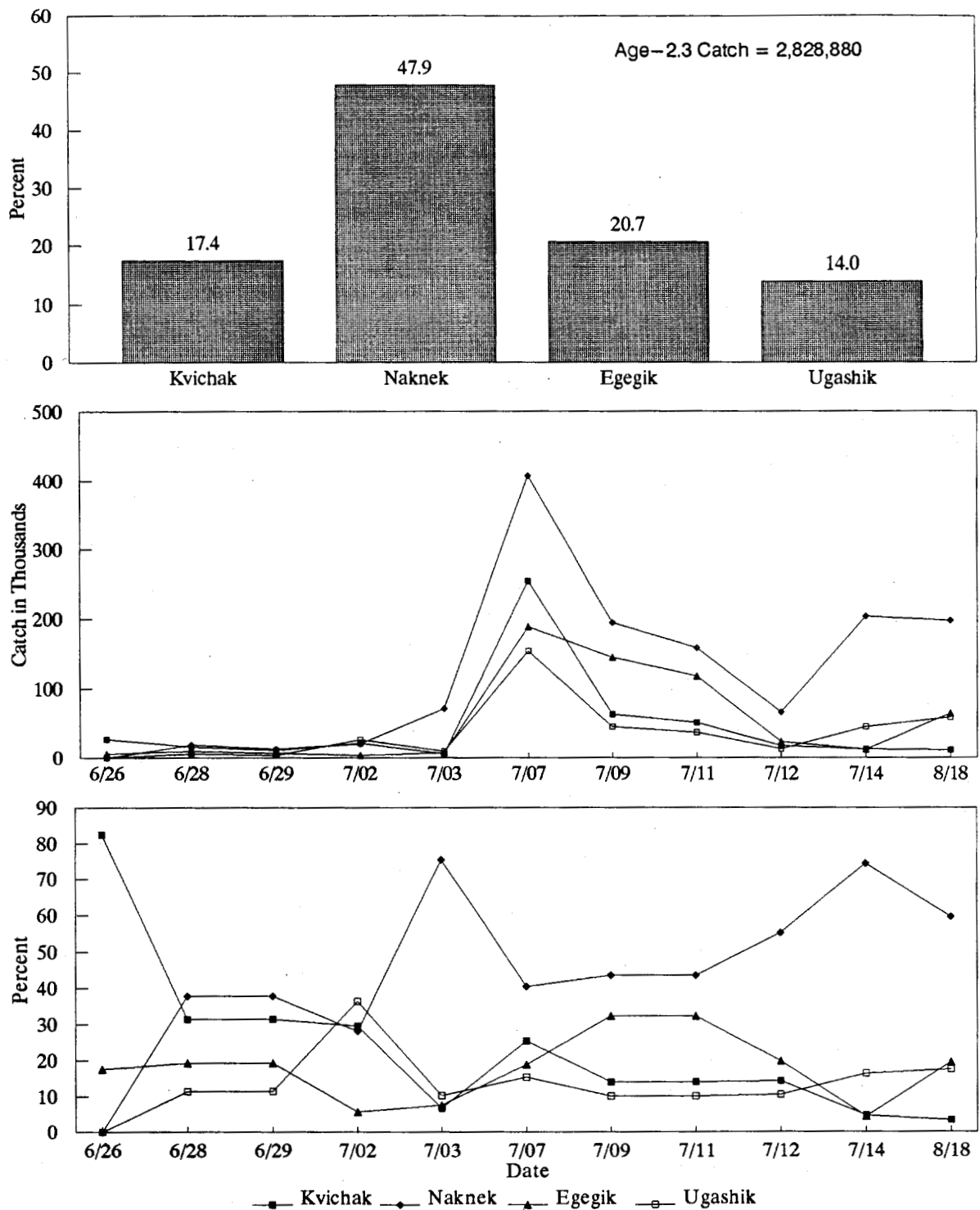


Figure 10. Stock composition estimates for 1992 Naknek-Kvichak District age-2.3 sockeye salmon catch in percent and numbers through time.

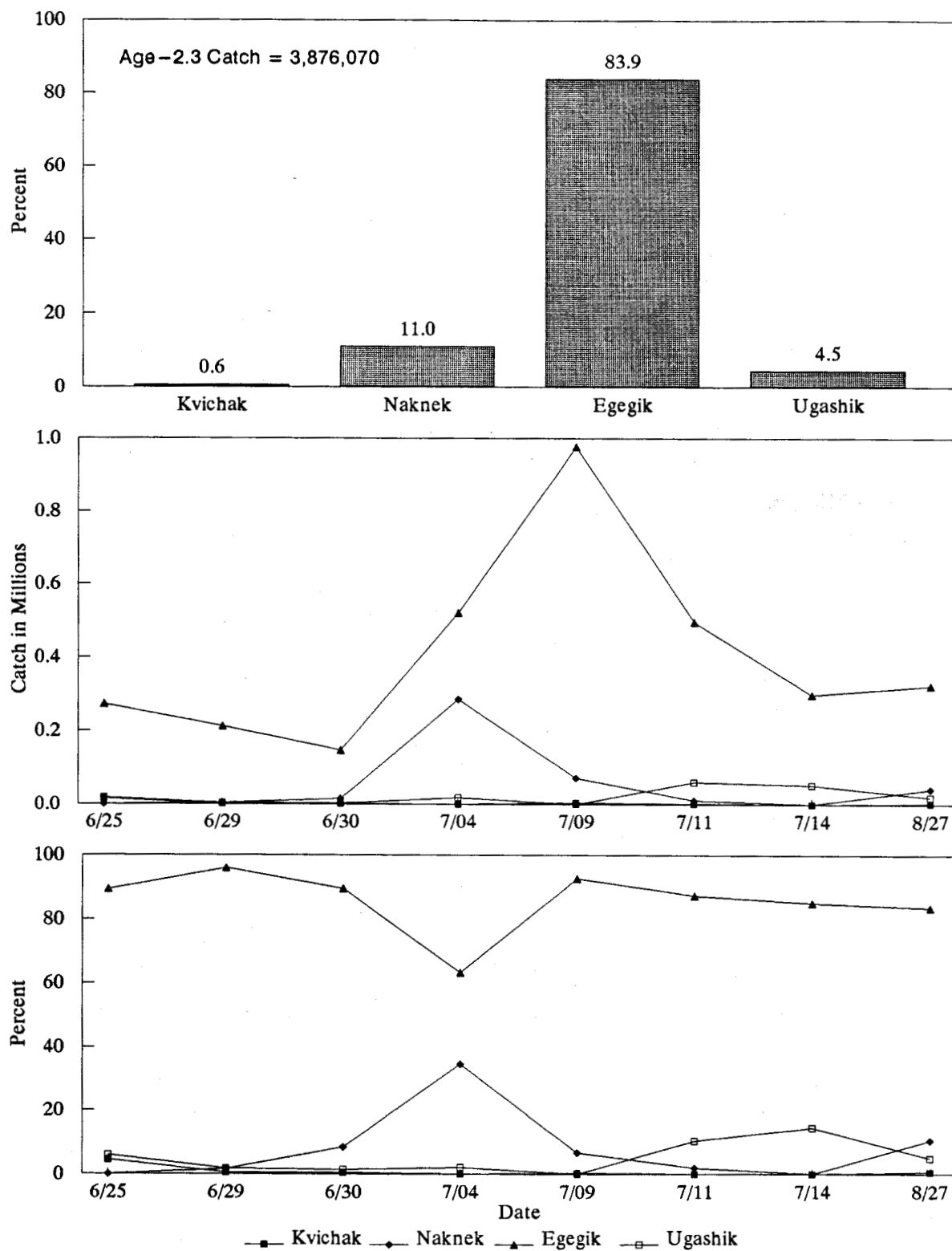


Figure 11. Stock composition estimates for 1992 Egegik District age-2.3 sockeye salmon catch in percent and numbers through time.

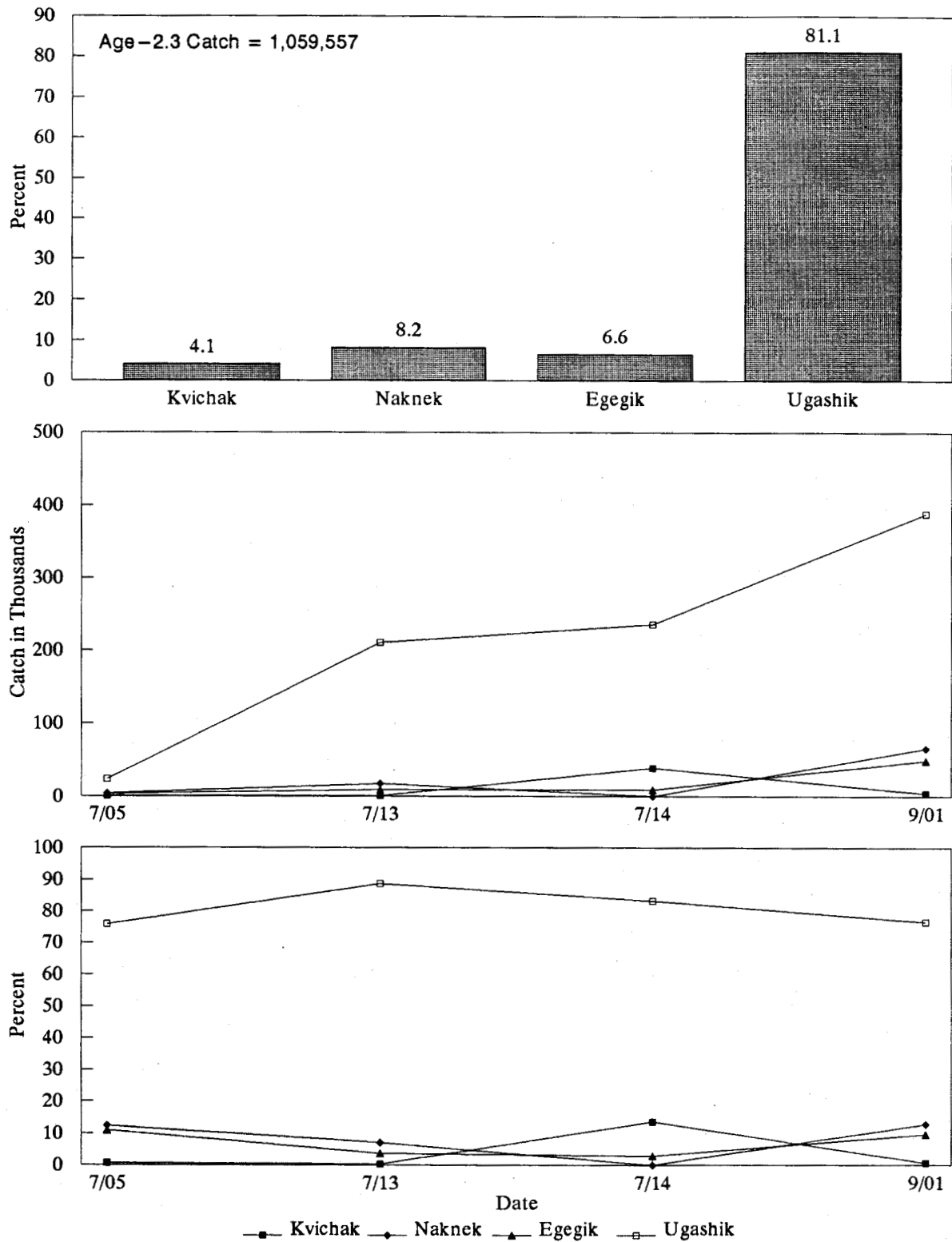


Figure 12. Stock composition estimates for 1992 Ugashik District age-2.3 sockeye salmon catch in percent and numbers through time.

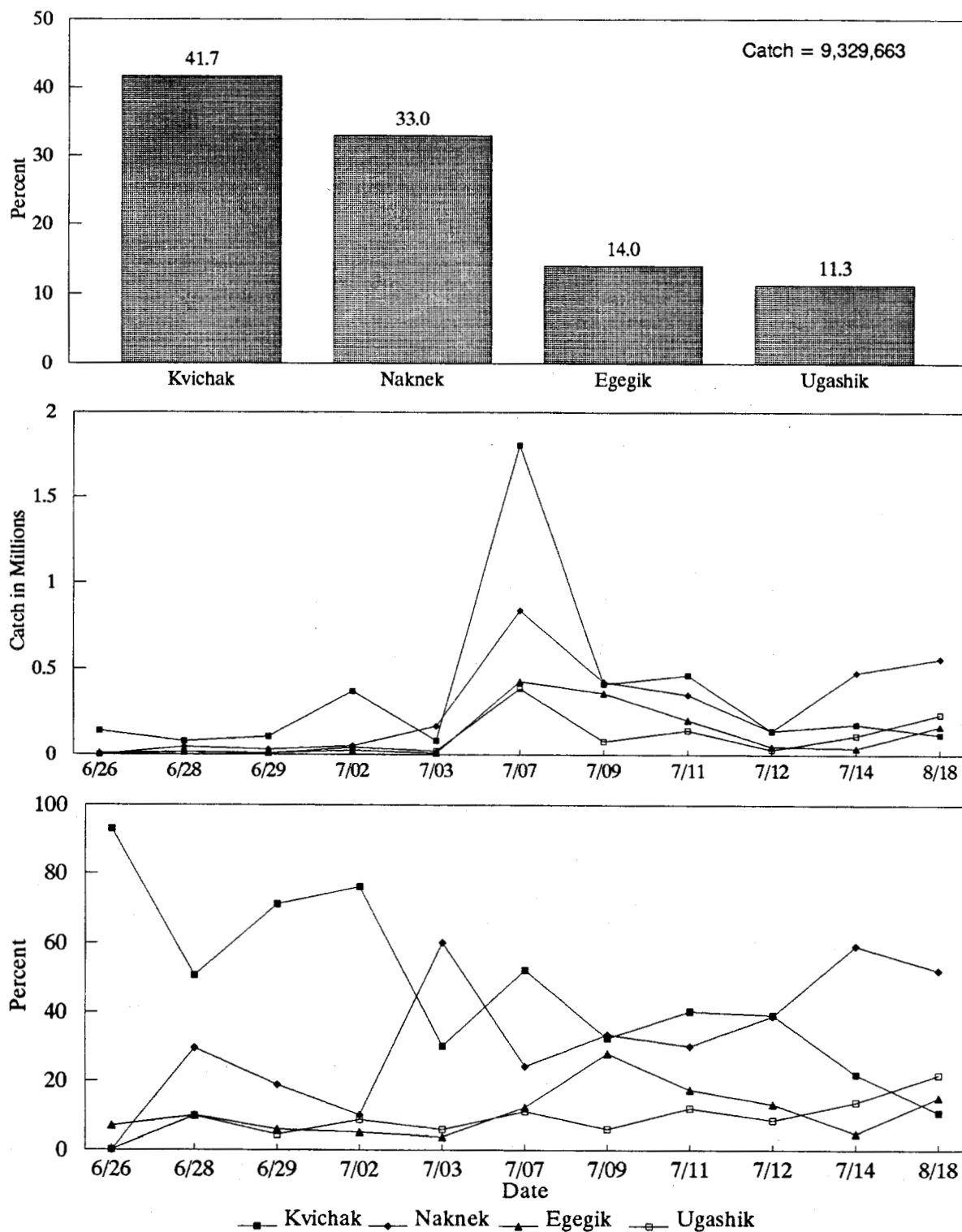


Figure 13. Stock composition estimates for 1992 Naknek-Kvichak District total sockeye salmon catch in percent and numbers through time.

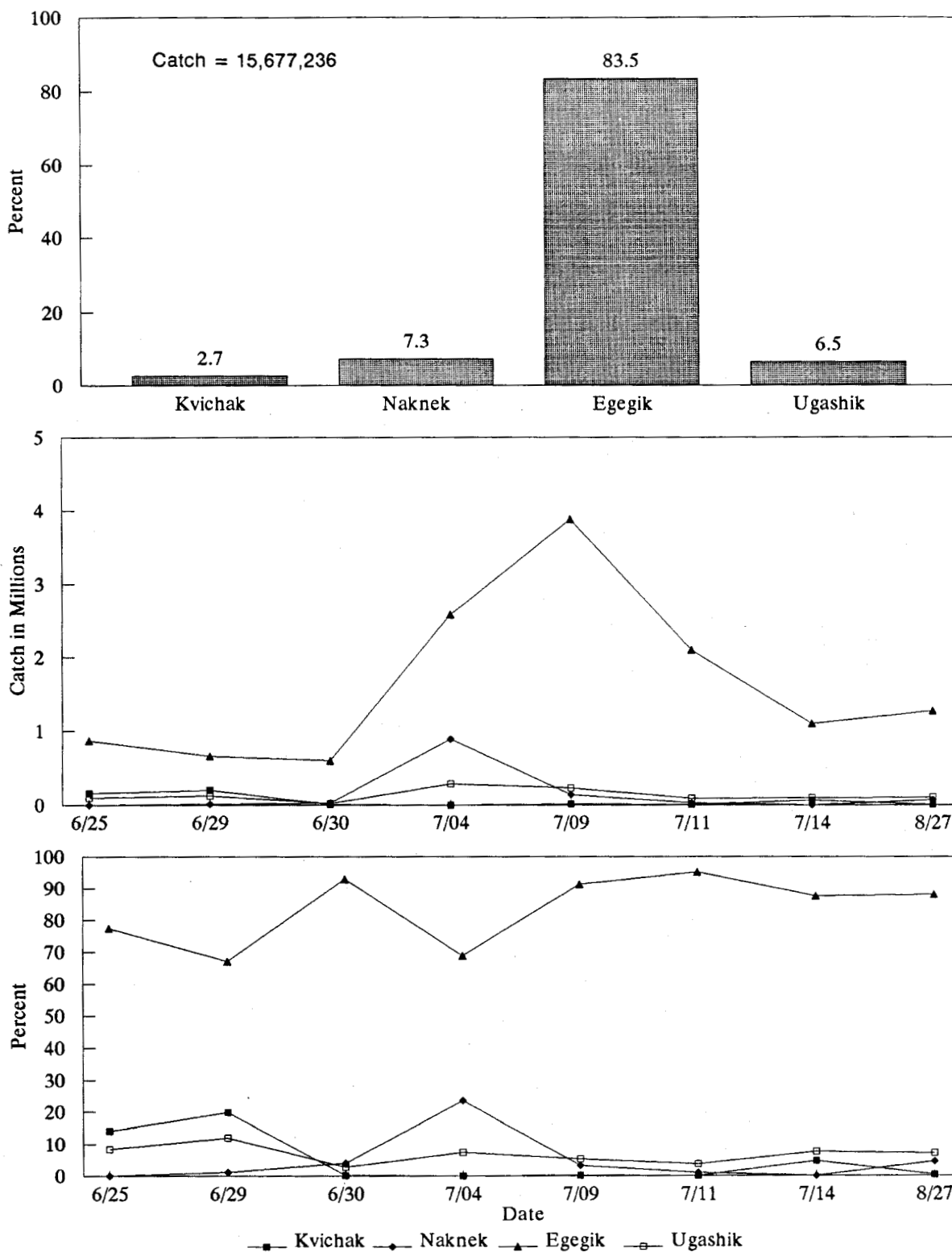


Figure 14. Stock composition estimates for 1992 Egegik District total sockeye salmon catch in percent and numbers through time.

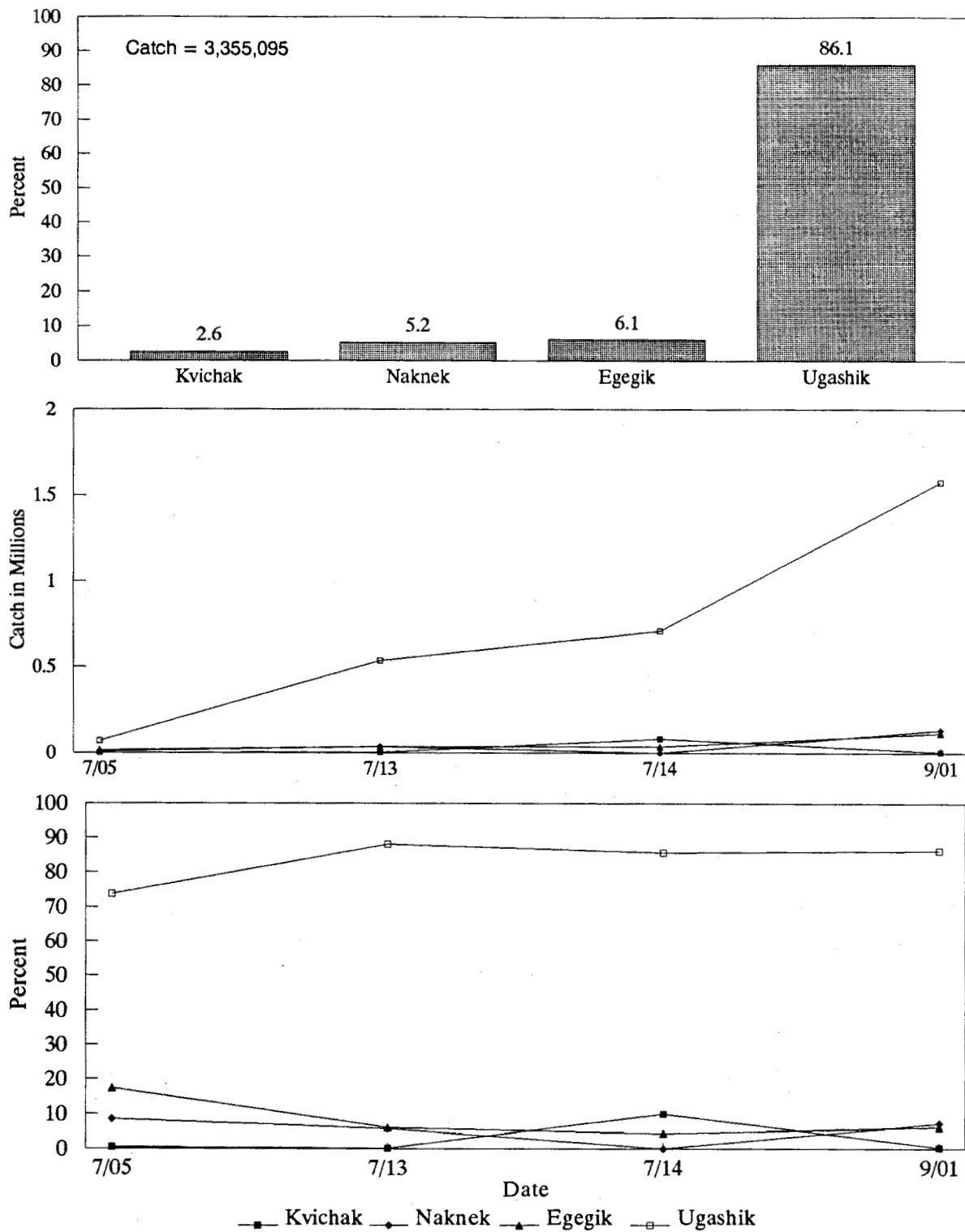


Figure 15. Stock composition estimates for 1992 Ugashik District total sockeye salmon catch in percent and numbers through time.

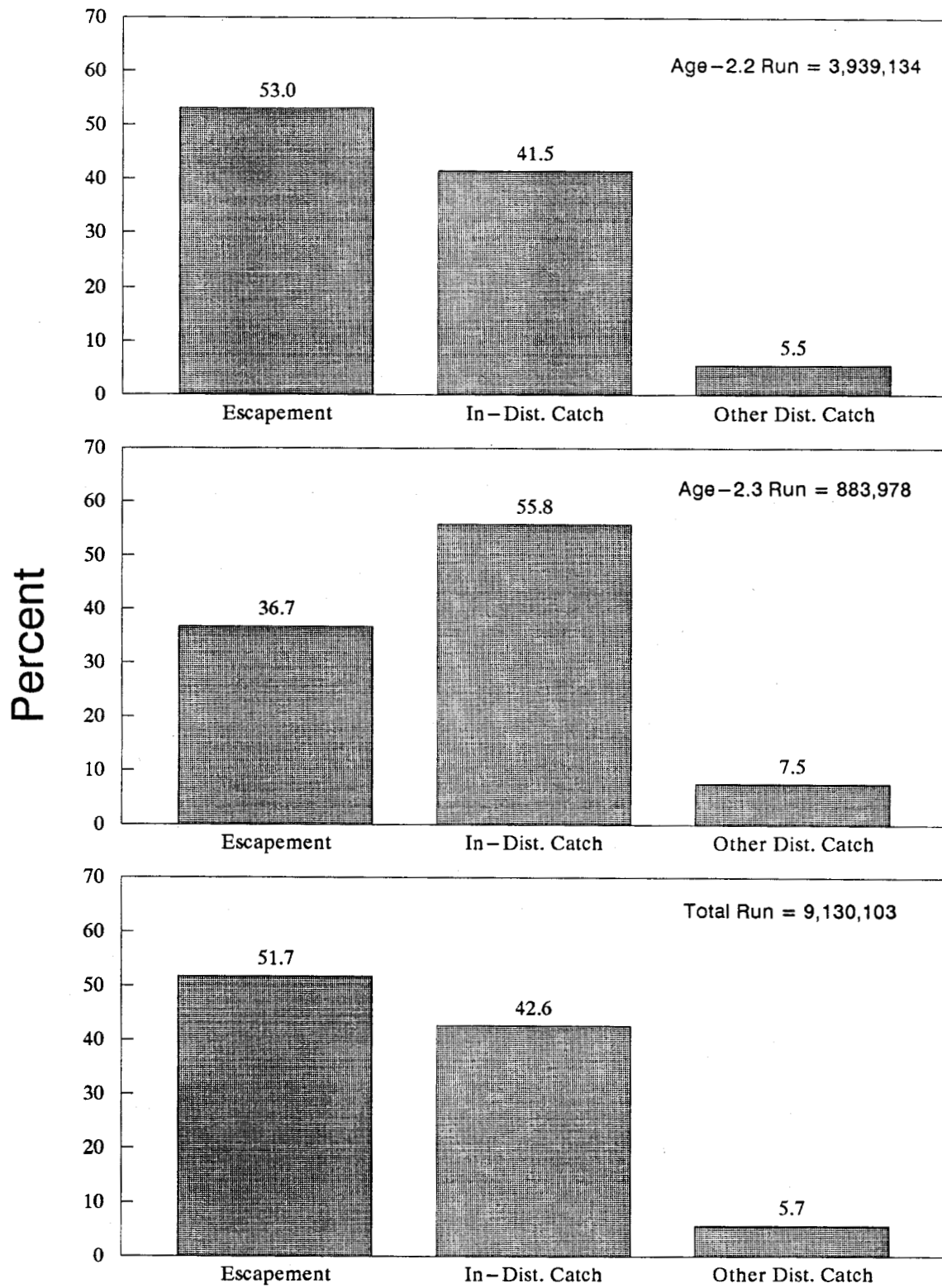


Figure 16. Estimated 1992 Kvichak River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

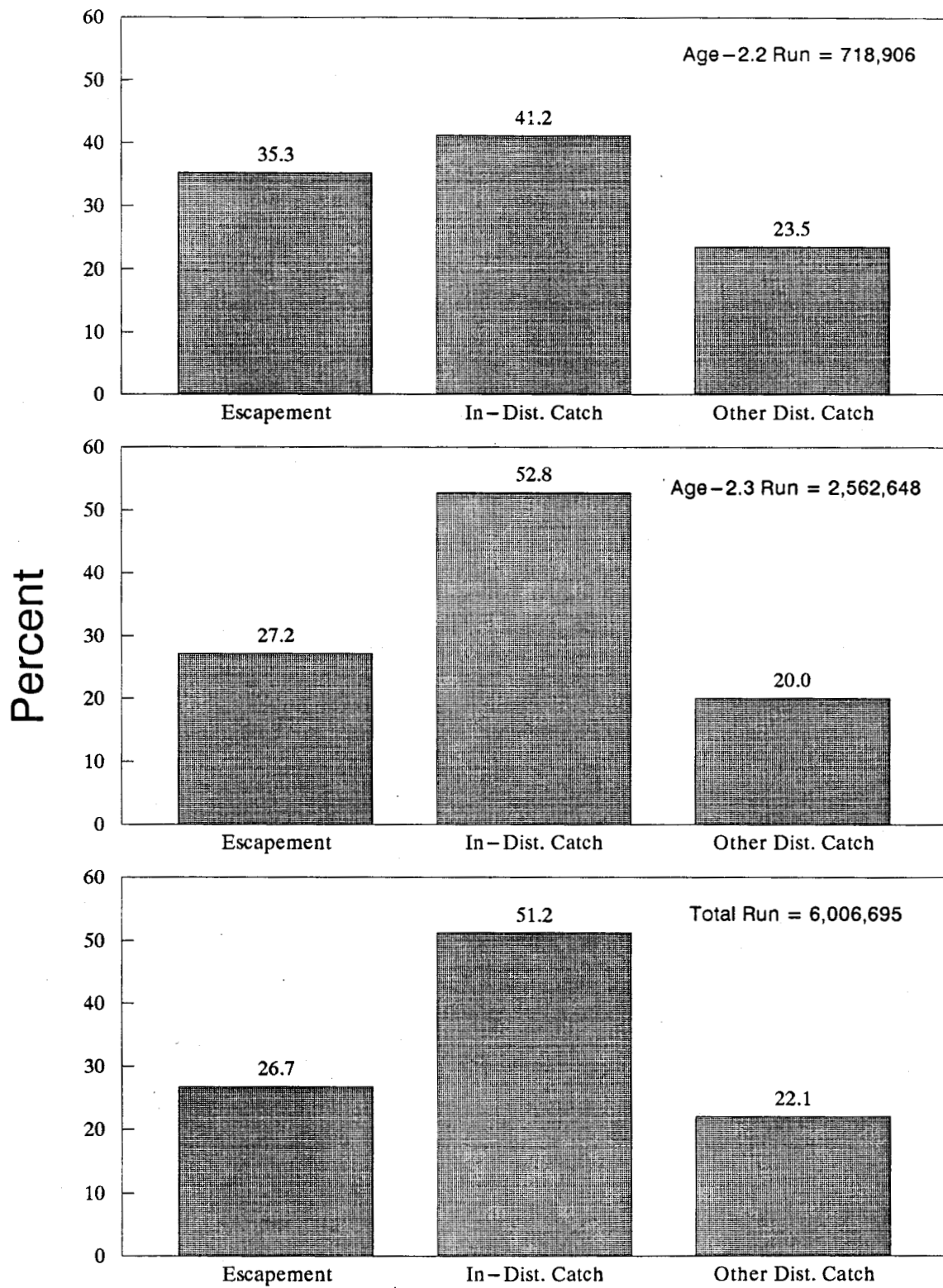


Figure 17. Estimated 1992 Naknek River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

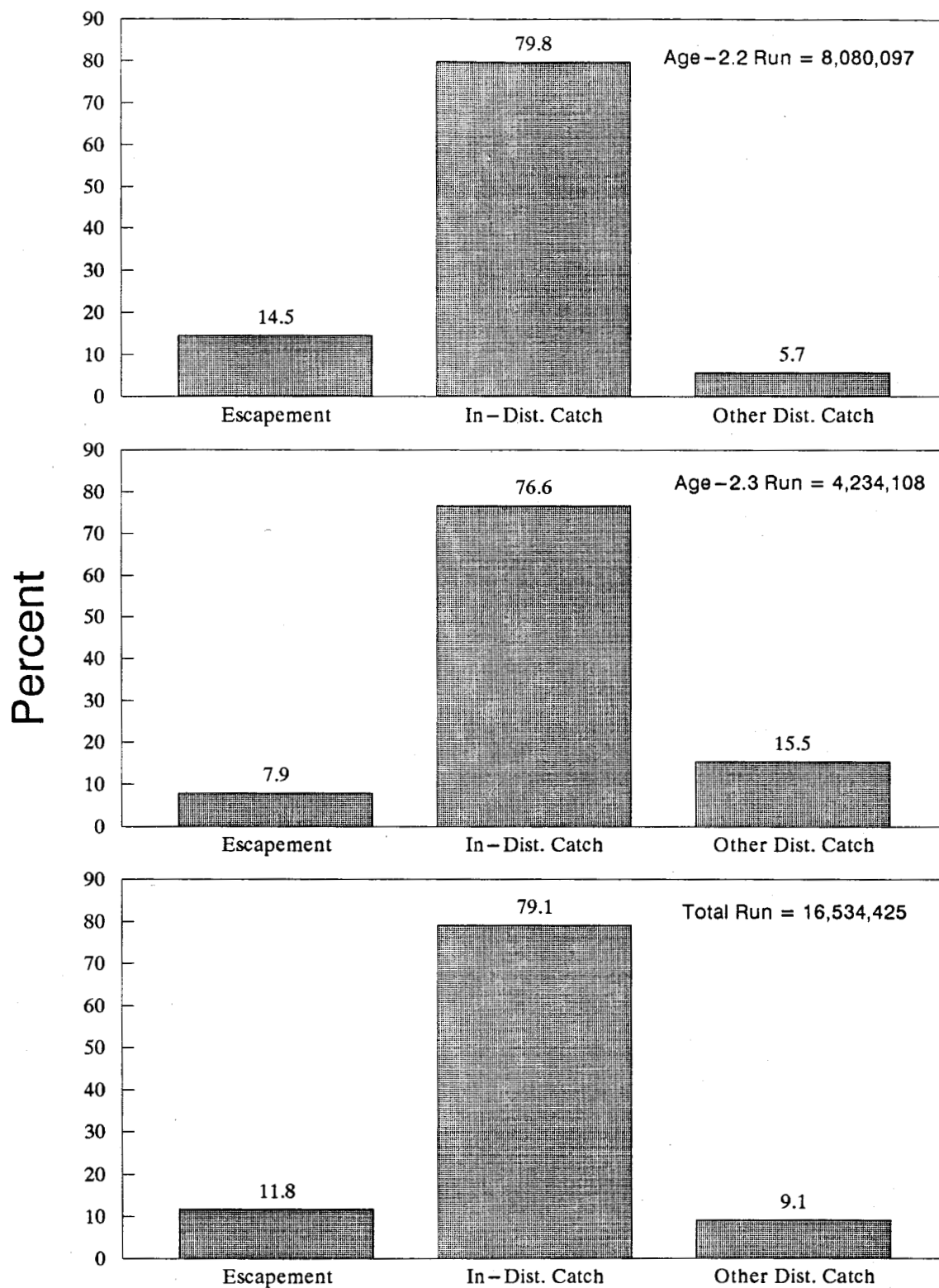


Figure 18. Estimated 1992 Egegik River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

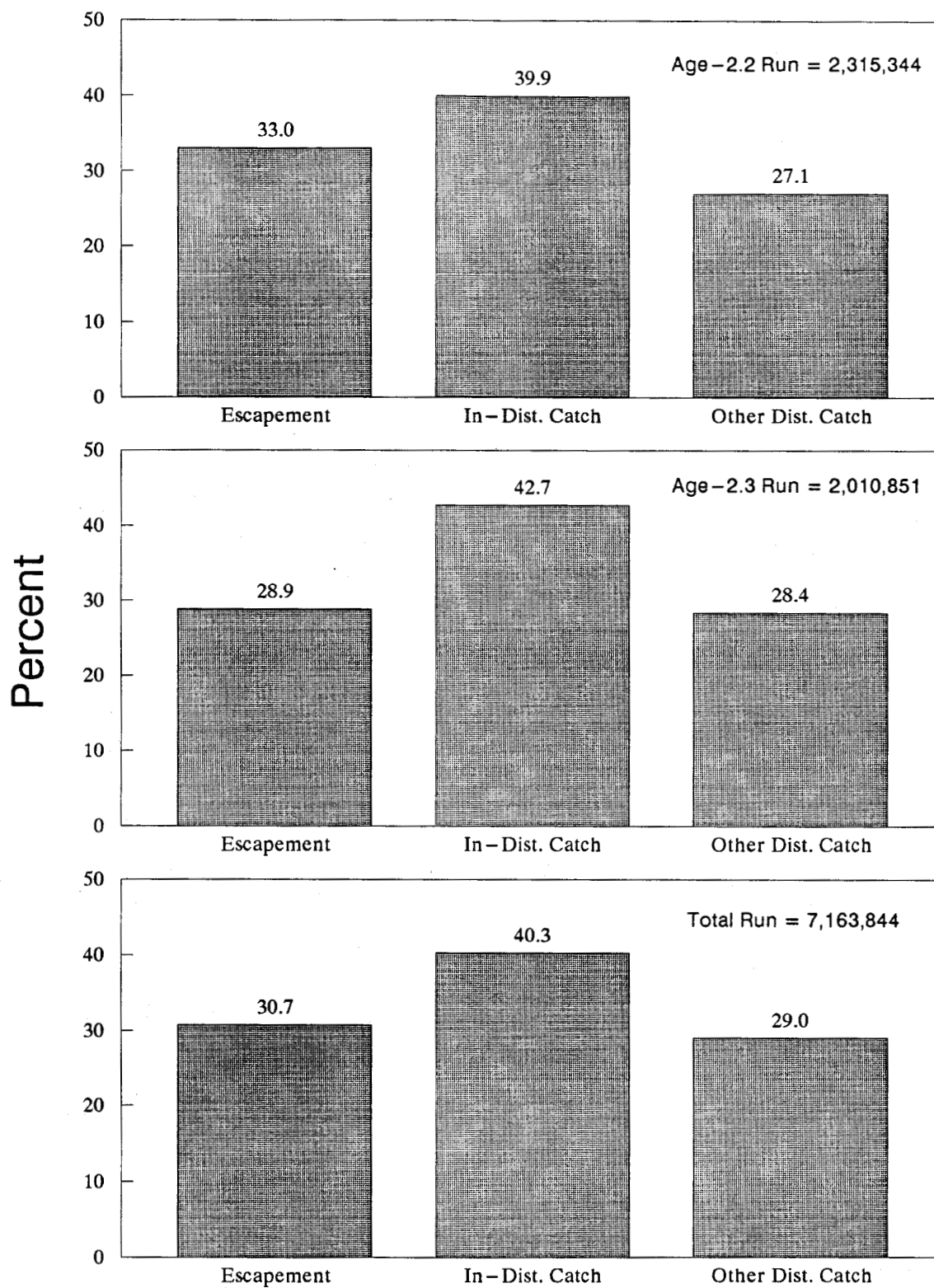


Figure 19. Estimated 1992 Ugashik River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

APPENDIX

Appendix A. Scale variables screened for linear discriminant function analysis of age-2.2, and -2.3 sockeye salmon for the Eastside of Bristol Bay, 1992.

Variable Number	Variable Name	Zone
<u>First Freshwater Annular Zone</u>		
1	NC1FW	Number of circuli first freshwater
2	S1FW	Size (width) of first freshwater
3 (16)	C0-C2	Distance, scale focus (C0) to circulus 2 (C2)
4 (17)	C0-C4	Distance, scale focus to circulus 4
5 (18)	C0-C6	Distance, scale focus to circulus 6
6 (19)	C0-C8	Distance, scale focus to circulus 8
7 (20)	C2-C4	Distance, circulus 2 to circulus 4
8 (21)	C2-C6	Distance, circulus 2 to circulus 6
9 (22)	C2-C8	Distance, circulus 2 to circulus 8
10 (23)	C4-C6	Distance, circulus 4 to circulus 6
11 (24)	C4-C8	Distance, circulus 4 to circulus 8
12 (25)	C(NC-4)-E1FW	Distance, circulus (number circuli first freshwater minus 2) to end first freshwater
13 (26)	C(NC-2)-E1FW	Distance, circulus (number circuli first freshwater minus 4) to end first freshwater
14	C2-E1FW	Distance, circulus 2 to end first freshwater
15	C4-E1FW	Distance, circulus 4 to end first freshwater
16 thru	C0-C2/S1FW ...	Relative widths, (variables 3-13)/S1FW
26	C(NC-2)-E1FW/S1FW	
27	S1FW/NC1FW	Average interval between circuli in first freshwater
28	NC 1ST 3/4	Number of circuli in first 3/4 of first freshwater
29	MAX DIST	Maximum distance between 2 consecutive circuli in first freshwater
30	MAX DIST/S1FW	Relative width, (variable 29)/S1FW
<u>Second Freshwater Annular Zone</u>		
31	NC2FW	Number of circuli second freshwater
32	S2FW	Size (width) of second freshwater
33 (46)	E1FW-C2	Distance, end of first freshwater to circulus 2 (C2) in second freshwater
34 (47)	E1FW-C4	Distance, end of first freshwater to circulus 4
35 (48)	E1FW-C6	Distance, end of first freshwater to circulus 6
36 (49)	E1FW-C8	Distance, end of first freshwater to circulus 8
37 (50)	C2-C4	Distance, circulus 2 to circulus 4
38 (51)	C2-C6	Distance, circulus 2 to circulus 6
39 (52)	C2-C8	Distance, circulus 2 to circulus 8
40 (53)	C4-C6	Distance, circulus 4 to circulus 6
41 (54)	C4-C8	Distance, circulus 4 to circulus 8
42 (55)	C(NC-4)-E2FW	Distance, circulus (number circuli second freshwater minus 4) to end second freshwater
43 (56)	C(NC-2)-E2FW	Distance, circulus (number circuli second freshwater minus 2) to end second freshwater
44	C2-E2FW	Distance, circulus 2 to end second freshwater
45	C4-E2FW	Distance, circulus 4 to end second freshwater
46 thru	E1FW-C2/S2FW ...	Relative widths, (variables 33-43)/S2FW
56	C(NC-2)-E2FW/S2FW	
57	S2FW/NC2FW	Average interval between circuli in second freshwater
58	NC 1ST 3/4	Number of circuli in first 3/4 of second freshwater
59	MAX DIST	Maximum distance between 2 consecutive circuli in second freshwater
60	MAX DIST/S2FW	Relative width, (variable 59)/S2FW

-Continued-

Appendix A. (p 2 of 2).

Variable Number	Variable Name	Zone
<u>Plus Growth Zone</u>		
61	NCPG	Number of circuli in plus growth
62	SPGZ	Size (width) plus growth zone
<u>Freshwater and Plus Growth Zones</u>		
63	NC1FW + NC2FW	Total number of circuli first and second freshwater
64	S1FW + S2FW	Total size (width) of first and second freshwater
65	NC1FW+NC2FW+NCPG	Total number of circuli first and second freshwater and plus growth
66	S1FW+S2FW+SPGZ	Total size (width) first and second freshwater and plus growth
67	S1FW/S1FW+S2FW+SPGZ	Relative width, (variable 2)/S1FW+S2FW+SPGZ
68	SPGZ/S1FW+S2FW+SPGZ	Relative width, (variable 62)/S1FW+S2FW+SPGZ
69	S2FW/S1FW+S2FW+SPGZ	Relative width, (variable 32)/S1FW+S2FW+SPGZ
<u>First Marine Annular Zone</u>		
70	NC10Z	Number of circuli in first ocean zone
71	S10Z	Size (width) first ocean zone
72 (90)	EFW-C3	Distance, end of freshwater growth to circulus 3
73 (91)	EFW-C6	Distance, end of freshwater growth to circulus 6
74 (92)	EFW-C9	Distance, end of freshwater growth to circulus 9
75 (93)	EFW-C12	Distance, end of freshwater growth to circulus 12
76 (94)	EFW-C15	Distance, end of freshwater growth to circulus 15
77 (95)	C3-C6	Distance, circulus 3 to circulus 6
78 (96)	C3-C9	Distance, circulus 3 to circulus 9
79 (97)	C3-C12	Distance, circulus 3 to circulus 12
80 (98)	C3-C15	Distance, circulus 3 to circulus 15
81 (99)	C6-C9	Distance, circulus 6 to circulus 9
82 (100)	C6-C12	Distance, circulus 6 to circulus 12
83 (101)	C6-C15	Distance, circulus 6 to circulus 15
84 (102)	C9-C15	Distance, circulus 9 to circulus 15
85 (103)	C(NC-6)-E10Z	Distance, circulus (number circuli first ocean minus 6) to end first ocean
86 (104)	C(NC-3)-E130Z	Distance, circulus (number circuli first ocean minus 3) to end first ocean
87	C3-E10Z	Distance, circulus 3 to end of first ocean
88	C9-E10Z	Distance, circulus 9 to end of first ocean
89	C15-E10Z	Distance, circulus 15 to end of first ocean
90 thru	EFW-C3/S10Z ...	Relative widths, (variables 72-86)/S10Z
104	C(NC-3)-E130Z/S10Z	
105	S10Z/NC10Z	Average interval between circuli in first ocean
106	NC 1ST 1/2	Number of circuli in first 1/2 of first ocean
107	MAX DIST	Maximum distance between 2 consecutive circuli in first ocean
108	MAX DIST/S10Z	Relative width, (variable 107)/S10Z
<u>Second Marine Annular Zone</u>		
109	S20Z	Size (width) of second ocean zone

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